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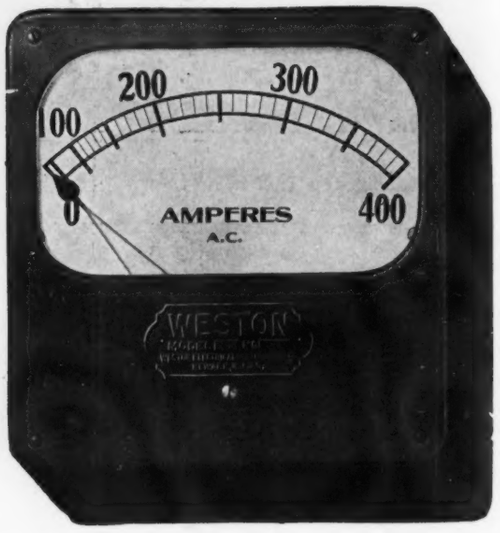

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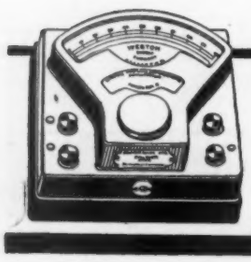

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Electrical World

THE CONSOLIDATION OF ELECTRICAL WORLD, ELECTRICAL ENGINEER AND AMERICAN ELECTRICIAN

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W. H. ONKEN, JR.

Editor

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A Retreat and a Tribute

THE battle for the control of the Philadelphia Electric Company is over. Much ink has been shed and the reverberations of newspaper artillery have been heard far from the ramparts whence the assaulting troops have retired in disorder. In another column will be found the letter addressed by T. E. Mitten to Joseph B. McCall and Walter H. Johnson in which the chairman of the Philadelphia Rapid Transit Company's executive committee informs the chairman of the board and the president of the light and power company that he has discontinued his fight for proxies and that those obtained will not be voted in opposition to the existing management of the Philadelphia Electric.

Mr. Mitten's letter is not ungenerous. It says with commendable frankness: "Your more than twenty thousand small stockholders were so impressed with your published assurances that you were still in control that they, over and over again, expressed a willingness to lose all that they had invested in your company, if that should be the outcome, in order to stand by you in response to your call." Very grateful must this acknowledgment be to the men at the head of the great light and power utility in Philadelphia, even though, as Mr. Mitten says, it brings with it a "greatly added responsibility." It is incontrovertible proof that the stockholders of the company stand behind the management and that the confidence and loyalty of these supporters are not to be shaken by even that most insidious and effective of all appeals, the appeal to the pocketbook. To Mr. McCall, Mr. Johnson and the other officers of the Philadelphia Electric Company the hearty congratulations of the industry they serve will be extended. Like Horatius and his companions of old (if we may vary our military metaphor), they have kept the bridge and even the ranks of Tuscany have not forborne to cheer.

Unit Stations Reduce Costs

THERE is only one valid basis of judging the worth of a generating station—the cost of power at the switchboard under reliable operating conditions. Yet in many cases stress is laid upon the heat units used per unit of output, at the expense of cost and reliability.

With the increase in size of stations and the corresponding reduction in cost per unit of capacity design changes have occurred which also reduce costs. These changes in design are incorporated in the idea of unit stations and unit equipment within stations. Two boilers, one turbo-generator, one transformer and the corresponding auxiliaries are frequently found in modern practice. This has eliminated building space, piping, low-tension busbars, oil breakers and many auxiliary devices which cost money and has increased the simplicity and reliability of the installation. It is suggested that a few years will see a unit boiler, turbine, generator and transformer installation without any space separation in order to reduce still further the cost of building, valves, piping, partition walls, switch house and switches.

The present trend in design is toward simplicity and unit operation, and this in turn is made possible by the growth of large interconnected high-tension transmission systems whereby the output of these unit equipments can be used most advantageously and the reserve capacity per station can be reduced to a minimum. Natural growth and intelligent engineering have thus enabled the light and power industry to go forward with generating-station development on a basis which retains low investment costs per unit of capacity in the face of rising prices of labor and materials.

Willing Help in Radio Trouble Prevents Unjust Blame

THE popularity of radio has made all the world partners in the problem of overcoming interference. Although the chief causes of disturbance arise from the elusive phenomena of nature, the lay enthusiast is always eager to attach the blame to some definite person, institution or other tangible entity. State legislators of Indiana think they have found a scapegoat in the form of "every person, firm or corporation manufacturing and distributing electrical energy." Such individuals or corporations would be ordered by a bill introduced in the Legislature to provide and maintain an inspection department for investigating and remedying any and all causes of radio interference arising from the operation of electric systems in the state.

The introduction of such a bill emphasizes strongly the importance of the utilities educating the public to the real causes of interference and emphasizing the small part that the electric utility plays in the sum total of radio disturbances. The public should be shown that as between the known causes of disturbance—namely, natural causes, broadcasting stations, receiving apparatus and stray currents—the first is more important than all the others combined and the last is least important of all. It would be worth while to point out some of the findings of the National Electric Light Association based on its extensive investigation of alleged radio interference by power lines. This investigation showed that of the small percentage of disturbances arising from conditions existing on such lines, the majority could be traced to wiring or appliance installations on the premises of the person reporting the trouble. Sources of this local disturbance were found in the operation of switches, appliances or any equipment giving rise to periodic interruptions or pulsa-

tions of the electric current. Another cause of disturbance was found to be the operation by radio listeners of antennas in close proximity to and parallel with high-voltage power lines—a trouble which can be overcome, or at least minimized, by placing antennas at right angles to such power lines.

As a preliminary to the needed education of the public a sincere willingness on the part of the utility companies to co-operate in investigating any suspected interference from power lines, after the other causes of interruption have been eliminated, is the commendable attitude. This voluntary co-operation, backed by intelligent and continual educational effort, will be a powerful instrument in building good will among radio listeners, most of whom are utility customers. Although it is manifestly impracticable for power companies to attempt to investigate every case of suspected interference reported, it has been found feasible and desirable by some of them to co-operate with the local electrical and radio leagues. In this way experiences can be exchanged and the leagues can bring to the attention of their members steps that can be taken to eliminate sources of trouble. It should also be possible for the power companies to obtain the co-operation of the radio press in carrying on the educational program and in bringing to the attention of readers the efforts of the power companies to reduce still further the small percentage of disturbance arising from the operation of their lines. The utilization of every avenue of approach to the radio public to define the company's very limited responsibility while making clear also its willingness to help will eventually teach the radio enthusiast that he must look elsewhere for a scapegoat.

Is Hotel-Room Lighting Going Backward?

A SURVEY of electrical development in any of its numerous phases generally shows progress, and the most severe criticism is usually that the progress is too slow. Rarely does one find stagnation or recession. Therefore it is somewhat startling to find that the wiring and lighting of the guest rooms of certain new hotels is distinctly retrogressive. In view of the rapid rate of development of electric lighting in recent years a backward movement in any of its many fields is nothing less than shocking. Nevertheless, this is the state of affairs if one is to judge by some of the newest hotels. In the guest rooms of one of these a ceiling fixture controlled by a wall switch is all the lighting there is except a faint and quite inadequate portable lamp near the bed. In the bathroom a lone bracket above the mirror controlled by a pull-chain socket comprises the entire wiring and lighting. This is retrogression indeed, and unfortunately it is found in the most modern and expensive hotels. Their backsliding is made particularly apparent by visiting some of the older hotels which have not the same gorgeousness perhaps but which radiate much solid comfort. The fixtures may be rather brassy and the shades may not be dense enough, but useful wall brackets are available, and there may be as many as four wall switches controlling the ceiling and wall fixtures.

Adequate wiring and lighting go a long way toward making a hotel room endurable. What an insignificant part of the cost of equipping a room such wiring and lighting is! Furthermore, the maintenance and depreciation cost of the electric equipment is negligible compared with that of furnishings. Certainly there is little excuse for going backward in this respect, but notable instances of such misplaced economy are discovered when the wiring and lighting of guest rooms in some new hotels are compared with the system in first-class hotels which were new a score of years ago.

More Consideration for the Sales Department

EVERY commercial man in the central-station industry will accept with a considerable feeling of inward glee the responsibility which rests upon him and his confrères to obtain new and additional loads which will help to improve system load factors and thereby make for more efficient utilization of their companies' capital investment. Within the last two years more than one thinly veiled innuendo has been bandied about that commercial departments were "falling down on the job," that they only got the business which fell into their laps and that they were not really developing new opportunities. The present call for more and better business offers commercial men a golden opportunity for vindication.

Of the commercial man's alleged shortcomings and errors of omission may it not be said that he is more sinned against than sinning? Consider some of the handicaps under which the central-station salesman has had to work. Always he has had to operate in a pioneer field; the commodity which he had to sell, were it electric light, power or heat, was new to his prospective customer. It was not a staple article for which there was already created a large voluntary demand. His talking points were frequently intangible benefits about which the prospective user was more than ordinarily skeptical. He had to talk and talk hard to gain even so much as a "trial installation," and after that it was just as big a job to keep the customer convinced. In the early days, before much thought had been given to public relations, the words "I represent the electric light and power company" were not an "open sesame." Far from it. Power salesman have ever been confronted by an antagonistic attitude on the part of operators of private plants. The road of the residential salesman has been no smoother; in fact, it has been particularly trying at times, especially after a morning of unresponsive doorbells on a house-to-house canvass when the "prospect" list looked about as inspiring as a last year's bird's-nest. Then, too, in the old days—and it is still true to a degree—there was ever hanging over the sales force the threat of a cut in the department because of the well-known retrenchment policy or because of seasonal business. Laying out and following up a plan of continuous selling which utilizes the entire department at its maximum efficiency the year around is a comparatively recent practice. Truly, taking it by and large, the lot of the central-station selling man has been no sinecure. It has been a stiff, competitive, uphill pull all the way, and let it be said to the credit of the old heads that they have stuck it out.

Now there apppears an urgent demand for the services of the new-business department, and the growth of the industry which its leaders visualize can be accomplished only through the medium of greater sales.

Thus opportunity has finally knocked at the commercial man's door. He has been made responsible for the future growth of the industry and can now cash in on the years of missionary work which have so far paid him a very meager return either in the form of words of encouragement or in that of actual monetary compensation. One thing which he does need, perhaps more than all else, if he is to accomplish what is expected, is the sympathetic support of the executive in working out his problems. To a certain extent sales programs can be plotted and worked out on paper and carried through in a routine manner, but the central stations' new-business program involves more than just the marketing of a certain number of units of a commodity. The increased sale of kilowatt-hours means also better customer, public and trade relations, all of which need the combined thinking and understanding of central-station executives and their commercial men.

Automatic Unloading of Feeders

CONSIDER a number of feeders in parallel, all fairly well loaded in regular operation. In case of a fault in one of the feeders it will be cut out by its selective relays, but then the currents in the remaining feeders may become sufficiently high for the overload relays to operate. Thus a fault in one of the feeders would cause a complete interruption in the supply of power to that particular substation. An alternative means of protection is so to arrange the relay protection that an excessive current in a feeder would first disconnect part of the load, instead of opening the feeder itself. Paraphrasing a biblical saying, it is better to lose part of the load than the whole supply. By a proper adjustment of current and time settings in the relays it should be possible to disconnect the load in steps, beginning with its least essential parts.

Perhaps this method has been used in isolated cases in this country, but we do not recall any published information to that effect. This makes especially welcome an article on the subject by M. Schleicher (*Elektrotechnik und Maschinenbau*, 1924, Vol. 42, page 453), in which this system of protection is described in detail, with examples showing its application to a ring system, to a substation fed by two feeders in parallel and to a private generating plant interconnected with a public utility line.

The Engineer and General Culture

TO BE able to express one's self logically and concisely is a rare accomplishment. Not many men, be they lawyers, doctors, clergymen or engineers, possess the gift of persuasive eloquence, even though they be steeped in the classics and ooze with general culture. The engineer, however, of all professional men, is probably the narrowest in general training. Not that he should, as Professor Greene, dean of the School of Engineering at Princeton, suggests, possess an imagination "equal to that of the novelist, the artist, the poet or the preacher"—Heaven forbid!—but that he should have such a background of English literature and such a command of rhetoric as to be able to express himself convincingly and understandingly. Otherwise men more glib of tongue or pen will carry off the prize.

An engineer is, by training, decisive and precise. He deals with facts, not fiction. But if he is to become great in his profession, he must broaden and rise above the slide rule, the grease and the machinery. To engineering as his lifework his main devotion must be given, but he will be a better engineer for seeking, occasionally at least, the relaxation, delight and inspiration to be found in the less severe pursuits connected with a love for literature, music or art.

Railroads Move Less Coal

RECENT statistics show that the railroads carry less coal in proportion to other freight with each succeeding year. In 1922 about 24 per cent of the total was coal, in 1923 only 22 per cent was coal, in 1924 only 20 per cent and in 1925 only 18 per cent was coal. This slump in coal haulage in the face of increased general haulage is caused by an increased economy in the use of coal and by the replacement of coal power by a cheaper power. The railroads themselves, because of economies in fuel, used 15,000,000 tons less coal last year than in 1920 and yet used more motive power.

But the greatest influence in the decreased haulage has been the growth of the light and power industry. Manufacturers no longer pay enormous freight and fuel bills. Instead they use central-station energy. The utilities have developed all possible hydro-electric energy and in a number of cases have built huge plants at the mouths of mines. Even when not so located the large utility stations use only a little over one pound of fuel where from five to ten pounds is used by the average industrial plant. The decrease in the amount of coal hauled by railroads may affect their incomes slightly, but it will result in ultimate economy. The moral is that a cheaper way of supplying and using coal has been found.

Maximum Efficiency in Decisions

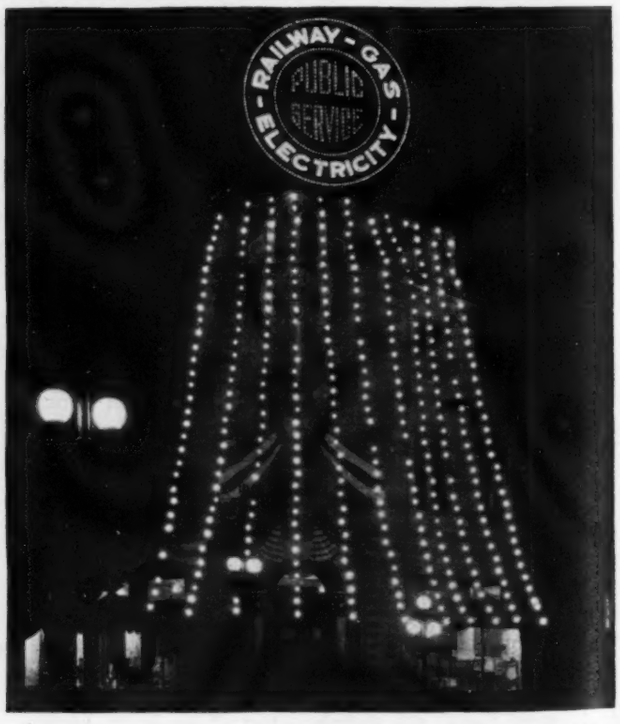
OPINIONS are very frequently excuses for ignorance or laziness in an industry which is founded on a quantitative science and which is sufficiently young to have available every fact associated with its past developments and present operations. Mere opinion, therefore, should have little weight unless supported by evidence. Yet often views are expressed and accepted without proofs by the electrical industry and organized work is started which is predicated on unsupported assumptions. Naturally a 50 per cent average of success may be expected under these conditions, but the fact remains that much waste and many false moves can be eliminated if every individual and organization will investigate and then apply facts intelligently.

In some industries the engineer, the commercial man and the executive must give decisions based on opinion and judgment because facts are not available or, if available, because too much time and labor would be consumed to obtain them. But in the electrical industry conditions are different in that statistics, experiences, data and quantitative laws are readily available with a little expenditure of time or money, and, with the increasing magnitude of the industry, it becomes more and more imperative to act with actual facts as guides to accomplishment. In an industry noted for the excellence of its engineering equipment it is easy and very important to secure 100 per cent efficiency in making decisions.

Mardi Gras Illumination in New Orleans

THE lavish carnival lighting of the Mardi Gras in New Orleans this year again demonstrated the fact that light never loses its attraction and that the continued revival which is noted in all parts of the country responds to a very widespread appeal by the public.

The illustrations show how part of 25,000 50-watt lamps were used in the decoration of public buildings, clubs and stores. The New Orleans Public Service building drew much attention by the beautiful effect of falling rays of light capped by the Public Service company sign.



Municipal Diesel Operation at Low Rates

How Two 550-Hp. Oil Engines of This Type Installed in a Michigan Plant Generate Electrical Energy at an Average Cost of 1.63 Cents per Kilowatt-Hour

By PHILIP S. JOY
Superintendent Marshall City Water and Electric Works, Marshall, Mich.

THE secret of successful and economical municipal operation of a power and lighting plant lies in the employment of efficient generating units. The reason why so many municipal plants in small and medium-sized towns appear to be making a failure of operation is that they attempt to sell energy at a price below the cost of production. Many such plants turn as a last resort to purchased energy from utility companies, not so much because of a possible reduction in rates or an assurance of better service as to become relieved of the troubles connected with the operation of a plant which has outlived its usefulness. Much antiquated steam apparatus is kept in service which can no longer operate economically.

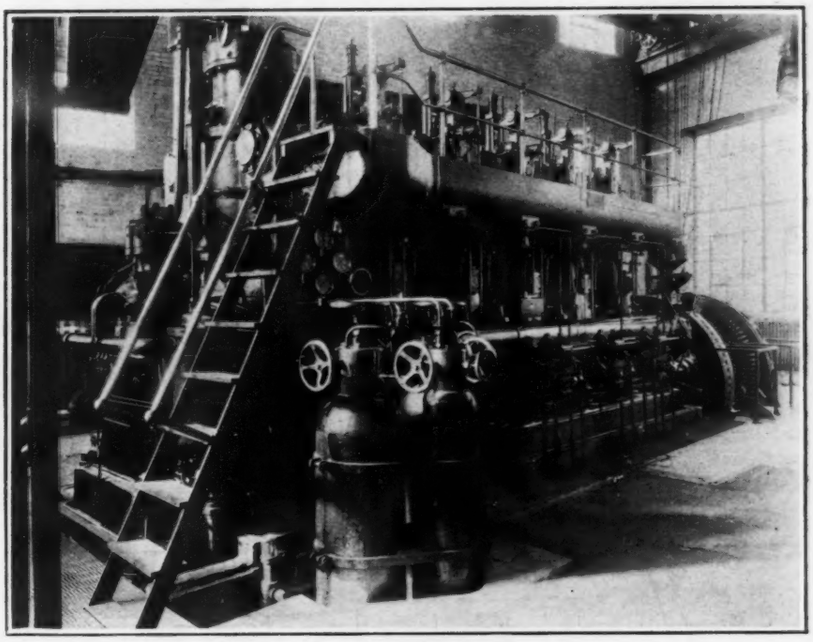


FIG. 1—ONE OF THE TWO 550-B.HP. NORDBERG DIESEL ENGINES INSTALLED AT THE MUNICIPAL PLANT, MARSHALL, MICH.

Failure, however, is not universal. For instance, the plant operated by the city of Marshall, Mich., which has a rating of 1,500 kw., is one which is showing excellent results both in its exceptionally low rates and in its record of performance, since it is operating on a sound financial basis. With two 550-hp. Nordberg Diesel engines installed in the early part of July, 1922, the rates for this community now stand as follows: Domestic lighting, 5 cents; business and factory lighting, 4 cents; power, 2½ cents. These low rates are due to three factors: First, the installation of a prime mover with high efficiency; second, the efficient management of the plant; third, the low maintenance expense of Diesel engines.

PLANT DEVELOPMENT

The original plant, installed in 1893, consisted of two 100-hp. waterwheels operating two Brush arc machines and one single-phase alternator. Since that time the plant has passed through various changes, the water-power plant being rebuilt and utilized to its fullest extent. In 1919 the central station from which energy was then being purchased notified the city of Marshall that after January 1, 1921, it would be necessary to add a demand charge to its existing rates. This would have increased the rate then in effect to about 4 cents. Since no more hydro-electric equipment could be installed, the only alternative seemed to be the installation of some other form of standby power at Marshall. Owing to the good results obtained from municipal operation, the purchase of more equipment was looked upon favorably by the citizens.

After making a careful investigation as to the choice of prime movers which would give the utmost assurance of reliability at the lowest cost of production, it was the unanimous opinion of the board of commissioners and the author that Diesel engines should be installed. The next move was to obtain an estimate of the cost of building a new power house, purchasing two Diesel engines, generators, exciters and a new switchboard. This investigation showed that such a new power plant could be installed by issuing $100,000 in bonds and spending the proceeds together with what money the plant had to its credit in the lighting fund. Upon referring this bond issue to the citizens the commission was authorized to proceed with the work by a vote of almost seven to one. Accordingly the work was started in the fall of 1921 and was finally completed on July 1, 1922. The plant, as shown in Fig. 1 and Fig. 2, completely finished, with auxiliary motor-driven high-pressure air compressors and cement fuel-oil tanks, cost $118,363.27. For the twelve months ended April, 1924, the net profit with costs and interest deducted was $18,693.71. Because of this profit, the outstanding bond issue has been reduced to $60,000, $10,000 being refunded before the issue became due. Because of the funds on hand and the judicious use of them it was necessary to issue only $85,000 of the $100,000 authorized bonds when the plant was finished.

At the time the Diesel engines were placed in service

the purchase of outside energy was discontinued, since there was no further need of this connection. It was the original intention to use the Diesel engines as standby units only to help carry the water-power plant over the peak loads. But, because of the gradual increase in the load and the constant decrease in the water flow, the Diesel engines have now become the main power units, handling the load during the peak period of greatest demand, as shown in Fig. 3a, a daily load curve on the plant. Naturally with this load condition, it is almost impossible for the Diesel plant to operate at the best efficiency. However, since the water is available and does not cost anything, it produces a most efficient over-all economy. One Diesel is kept on the line during the day load; but if there is sufficient water in the pond, one waterwheel is placed in operation. When the water drops below a certain level, the load is again switched over to the Diesel. The flow of the river is sufficient to take care of the night load from about 10 p.m. to 6 a.m. It will also be noticed that the load between 6 a.m. and 7 a.m. almost equals the peak load at night. A little later in the month of December, while business places are open in the evening, the peak will reach about 600 kw. A yearly load curve is given in 3b. In the spring of the year the engine-hour record is much less, owing to the abundant water power and to lighting load conditions.

A tabulation of a year's operation of the two Diesel engines is given in the table. The reason the lubrica-

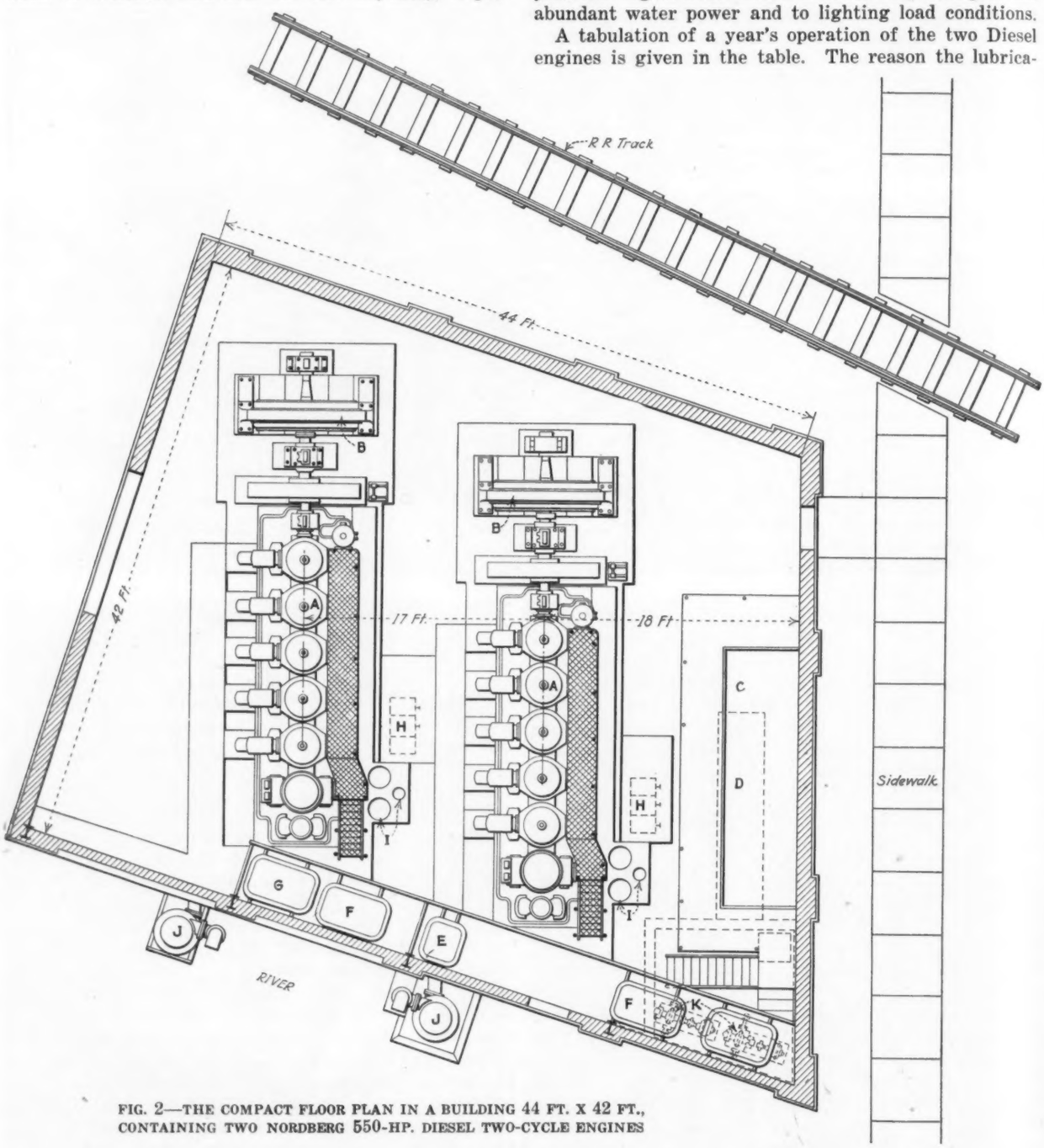


FIG. 2—THE COMPACT FLOOR PLAN IN A BUILDING 44 FT. X 42 FT., CONTAINING TWO NORDBERG 550-HP. DIESEL TWO-CYCLE ENGINES

A—550 B.Hp. Nordberg Diesel Engines.
B—400-Kw. A. C. Generators.
C—Switchboard Gallery.
D—Motor-Driven Exciters.
E—Light Fuel Oil Tank.
F—Heavy Fuel Oil Tank.
G—Lubricating Oil Supply Tank.
H—Lubricating Oil Filter.
I—Air Bottles.
J—Exhaust Silencer.
K—Motor-Driven Water Circulating Pumps.
L—Water Supply Sump.

tion expense for March, 1924, is high is because the oil on both engines was changed and because an accurate inventory of the fuel oil on hand is made in that month each year. Any discrepancy in the amount of oil charged out for each month against the total then on hand is evened up during March. The management changes the lubricating oil each year while the engines are new in order to keep the maintenance expenses low. The repairs in September, 1923, were largely the expense of one man sent from the Nordberg factory at Milwaukee to overhaul the engine. This is done each year because the operating crew of the plant consists of only two men, who work twelve hours a day and who do not work on any special overhauling. The additional labor is mostly accounted for by an increase in salary to the men who are operating the plant and to a third man who is normally employed on the lines, but who is given one day's work each week in the plant to acquaint him with the operation of Diesel engines. For the twelve months ended in March, 1924, the average cost of a kilowatt-hour delivered was 1.63 cents. Included in this cost are fuel, labor, repairs, sundries, lubricating oil and interest on bonds, overhead and distributing expense.

The total generation for the year for the 1,560 customers was 1,398,400 kw.-hr. Of this, the Diesel plant generated 636,300 kw.-hr., while the water turbines turned out 762,100 kw.-hr. Up to the present only one Diesel engine has been in operation at a time for the reason that there has been sufficient water power to carry a part of the load. A claim often made against Diesel engines is that they are expensive to maintain and that many repairs are required. For the year ended in March, 1924, the repairs in the Marshall plant amounted to $406.31, or $63.90 for each 100,000 kw.-hr. generated. As explained above, most of this was for annual overhauling, to keep engine in good condition.

ONE YEAR'S OPERATION OF DIESEL PLANT

(The high figures for repairs for September, 1923, are explained in the text.)

	Kw.-Hr. Diesel-Engine Production	Fuel-Oil Cost	Lubricating Oil Cost	Repairs	Additional Labor	Total
April, 1923	10,700	$93.49	$3.58	$0.00	$60.00	$157.07
May, 1923	18,500	185.64	8.45	0.00	60.00	254.09
June, 1923	42,800	347.91	16.48	0.00	60.00	424.39
July, 1923	47,900	355.44	13.98	0.00	70.91	440.33
August, 1923	59,600	522.14	17.88	48.60	129.40	718.02
September, 1923	63,700	411.60	14.63	214.01	60.00	700.24
October, 1923	80,400	550.83	16.90	118.73	143.57	830.03
November, 1923	95,100	699.89	19.50	0.00	85.83	805.22
December, 1923	69,600	515.97	15.93	13.95	79.63	625.48
January, 1924	64,400	505.85	20.18	0.00	80.76	606.79
February, 1924	58,700	414.12	13.98	10.20	80.00	518.30
March, 1924	24,900	330.63	222.20	.82	80.00	633.65
Total for twelve months	636,300	$4,933.51	$383.69	$406.31	$990.10	$6,713.61

The operating experience with the Marshall plant has been universally satisfactory, both in economy of operation and in reliability. Twenty-four-hour service is maintained with only two operators, which results in a much lower labor charge than is possible with a steam plant of the same size. It is generally believed by those not familiar with Diesel-engine operation that successful service requires specially trained Diesel engineers. This is not so. The operators at the Marshall plant had no previous knowledge of Diesel-engine care and operation prior to the installation of these engines. Their experience had been entirely confined to hydro-electric equipment. But by following the instructions given by the Nordberg factory erectors, with the application of ordinary power-plant knowledge, they have been able to maintain and operate the engines in a most satisfactory manner. The city of Marshall is fortunate in having two men who have taken hold of these engines and operated them so successfully.

A special oil-storage capacity was provided for the plant in the form of concrete fuel-supply tanks sitting partly above ground. These tanks have a capacity of 50,000 gal., providing enough fuel storage for about six months' operation, which permits purchasing oil not only in large quantities but at a time when prices are most favorable. During periods of oversupply of fuel oils it is often possible to take advantage of low prices. The oil is transferred by gravity from tank cars so that there is no expense incurred for oil handling. In order to keep the oil in a fluid state in the winter, the oil line from the tanks to the engine room is jacketed by a larger pipe, through which flows the warm water from the engine jackets. This water also passes through heating coils in the tanks, which keep the large supply of oil of such a fluidity that even in the coldest weather it can easily be handled by a pump.

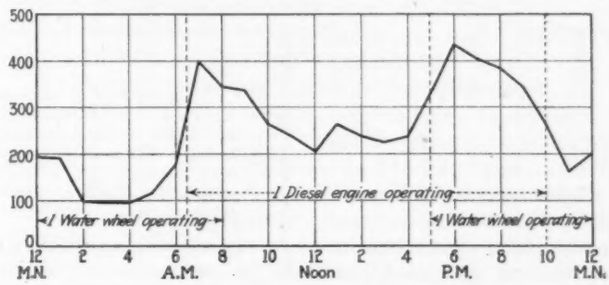


FIG. 3A—A DAILY LOAD CURVE FOR THE PLANT, GIVING THE TIME OF OPERATION FOR THE HYDRO AND DIESEL UNITS

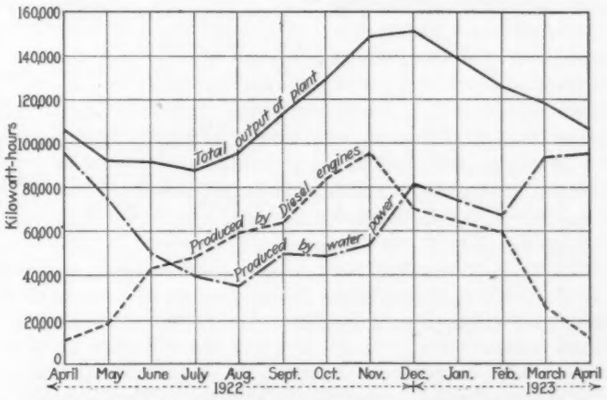


FIG. 3B—AN ANNUAL LOAD CURVE SHOWING THE LARGE OUTPUT FROM THE HYDRO UNIT DURING THE SPRING OF THE YEAR, IN ORDER TO OBTAIN HIGH OVER-ALL PLANT EFFICIENCY

Hydro-Electric Development in Italy

THE United States Consul in Charge in Turin, Italy, reports a great growth in hydro-electric power in the Piedmont district since 1914. This district is surrounded on three sides by the Alps, and the abundant water power furnished by their mountain streams has been intensively developed. In 1922 there were thirty-one companies with a total capitalization of more than $60,000,000 and an installed capacity of 470,000 hp. These companies not only supply Turin and all local needs but also supply the large cities of Milan and Genoa and the territory adjacent to them.

Finding Single-Phase Short-Circuit Currents on Calculating Boards

Explanation of Phase-Sequence System and Its Use to Simplify Calculations—The Six Steps Involved in the Solution—Practical Examples in Tabulated Form

By R. D. EVANS
General Engineer Westinghouse Electric & Manufacturing Company

THE method of calculating the magnitude and distribution of symmetrical polyphase short-circuit currents on complicated networks has now become well known. These calculations may be made analytically[1] or by means of the calculating board[2]. The calculations are usually made to determine the initial symmetrical value of the short-circuit current, and methods have been developed for determining the decrement in the short-circuit currents[3]. The method of calculating polyphase short-circuit currents has, therefore, been presented quite completely in the published articles[4]. In this article Mr. Evans discusses the use of calculating boards on single-phase short-circuit problems.

[1] "Analytical Solution of Networks," by R. D. Evans, *Electric Journal*, April and May, 1924, pages 149 and 207 respectively.
[2] "Calculating Short-Circuit Currents in Networks," by W. R. Woodward, *Electric Journal*, August, 1919, page 344.
[3] "A New Short-Circuit Calculating Table," by W. W. Lewis, *General Electric Review*, August, 1920, page 669.
[4] "Application of Decrement Factors in Short-Circuit Studies," by W. R. Woodward, *Electric Journal*, May, 1924, page 213.
[5] A bibliography is given in the paper "Experimental Determination of Short-Circuit Currents in Electric Power Networks," by O. R. Shurig, *Transactions* A. I. E. E., Vol. XLII, page 21.

THE type of short circuit which most frequently occurs on a polyphase system, particularly on a high-voltage system, is the single-phase short circuit, either from line to line or more particularly from line to ground on grounded neutral systems. It should perhaps be pointed out that the three-phase, the single-phase line-to-line and single-phase line-to-neutral short-circuit currents do not bear a simple proportional relation to one another and that any one of them may present the "worst case," depending upon system characteristics. The single-phase short circuit is difficult to calculate because of dissymmetry which produces unequal currents and voltage drops in the different phases which are inductively coupled in transmission line, transformer and rotating machines. Furthermore, rotating machines have a distinct balancing action which tends to restore the symmetry in voltage and current. Undoubtedly, it is this complexity of the problem that has prevented widespread use of methods for calculating single-phase short-circuit currents on three-phase systems. To C. L. Fortescue must be given the credit for the development of a method of analyzing the problems of unbalanced polyphase systems. This method* involves the resolution of an unbalanced or unsymmetrical system of voltages or currents into certain symmetrical components. The outstanding advantage of this method resides in the fact that each component may be analyzed separately in a manner similar to that now employed for the calculation of symmetrical three-phase short circuits. The solutions, of which three are required for the three-phase grounded neutral system, and which are independently derived, can be combined to determine the short-circuit currents for the three conditions, namely, three-phase short circuit, single-phase line-to-line short circuit and single-phase line-to-neutral short circuit.

It is to be pointed out that this method, employing the phase-sequence components, may be carried out by means of the calculating board if certain customary assumptions are made. These assumptions are as follows:

1. That the characteristics of transmission-line transformers and machines may be represented by series reactances (or impedances, that are all of the same power factor).

It should be pointed out that the earth connections introduce a certain amount of resistance in the earth-return circuits. The amount of this resistance is a variable quantity, depending largely upon local conditions, such as the nature of local grounds, the care with which they are installed, etc. The magnitude of ground resistance is difficult to approximate and can be determined satisfactorily only by test. For the purpose of this article, however, it seems desirable to ignore the effect of the resistance of ground connections.

2. That the internal voltages in machines are of the same magnitude and in phase with each other.

3. That the network is symmetrical in all phases, except, of course, at the point of single-phase short circuit.

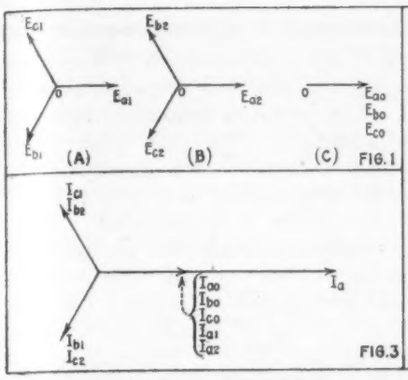
In view of the fact that the calculations can be carried out on a calculating board, it follows that the calculations are relatively easy to make and should be applied generally in all important short-circuit studies.

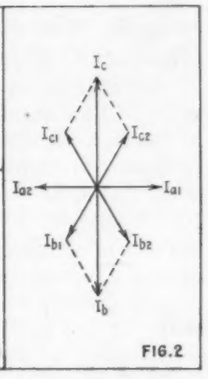
PHASE-SEQUENCE COMPONENTS

Before describing the method for calculating single-phase short circuits it is desirable to discuss briefly the subject of "phase-sequence components." This discussion, while not essential for the application of the method, is desirable in order to understand fully the method and its derivation.

On three-phase, four-wire or grounded neutral systems the voltages (or currents) of the line conductors may be represented by three vector expressions. It has been shown by Mr. Fortescue that these voltages can be replaced by three symmetrical components of

* "Method of Symmetrical Co-ordinates Applied to the Solution of Polyphase Networks," by C. L. Fortescue, *Transactions A. I. E. E., Vol.* XXXVII, page 1027.





RESOLUTION OF CIRCUITS TO SECURE SEQUENCE VALUES

Fig. 1—Sequence-voltage diagram. A—Positive-sequence voltages. B—Negative-sequence voltages. C—Zero-sequence voltages. (Voltages from line to neutral in phases *a*, *b* and *c*.)

Fig. 2—Sequence-current diagram for single-phase short circuit on phase *bc*.

I_{a1}, I_{b1}, I_{c1} = Positive-sequence currents
I_{a2}, I_{b2}, I_{c2} = Negative-sequence currents
I_b, I_c = Line currents in phases *b* and *c*
$I_a = I_{a1} + I_{a2} = 0$, line current in phase *a*.

Fig. 3—Sequence-current diagram for single-phase line to neutral short circuit on phase *a*.

I_{a1}, I_{b2}, I_{c1} = Positive sequence currents
I_{a2}, I_{b2}, I_{c2} = Negative-sequence currents
I_{a0}, I_{b0}, I_{c0} = Zero-sequence currents
$I_a = I_{a1} + I_{a2} + I_{a0}$ = Line current in phase *a*
$I_b = I_{b1} + I_{b2} + I_{b0}$ = Line current in phase *b*
$I_c = I_{c1} + I_{c2} + I_{c0}$ = Line current in phase *c*

voltages respectively. These voltages are designated "positive sequence," "negative sequence" and "zero sequence." The positive-sequence system of voltages involves three voltages of equal magnitude, but displaced 120 deg. in phase position, as indicated in Fig. 1A. The negative-sequence system of voltages involves three voltages, also equal in magnitude and displaced 120 deg. in phase position, as indicated in Fig. 1B. It will be noted that the sequence of voltage maxima of the negative-sequence system is opposite to that of the positive-sequence system. The zero-sequence system of voltages involves three voltages of equal magnitude and displaced 0 deg. from each other, as indicated in Fig. 1C. It is to be understood that the different sequence systems of voltages are, in general, unrestricted as to magnitude or phase relation with respect to each other. By a suitable combination of these three systems of voltages any combination of voltages on the three-phase system can be obtained, or conversely any combination of three-phase voltages can be resolved into these three-phase sequence components. The above discussion applies to currents as well as to voltages.

The resolution of a system of voltages into components is not new and is frequently employed to simplify the analysis of a problem. This method results in a very important simplification of the problem for the important case which we are considering, namely, symmetrical impedances in each phase of the system, except at the point of short circuit. This simplification resides in the fact that each of the phase-sequence components can be analyzed independently and the solutions combined. This arises from the fact that the positive-sequence voltage at one point is equal to the positive-sequence voltage at another point added to the drop produced by positive-sequence current flowing through the impedance between these points. Similar rules hold for the other phase-sequence components.

For symmetrical networks there are no sources of negative-sequence or of zero-sequence voltage, except that the dissymmetry at the point of short circuit produces in effect a negative-sequence voltage in case of a line-to-line short circuit, or both a negative and zero sequence voltage in case of a line-to-neutral short circuit. On this account each sequence system can be analyzed separately and combined in simple equations for the different types of single-phase short circuit.

A power transmission and distribution system will have network branches, including rotating machines, which branches, in general, possess different impedances to positive, negative and zero-sequence currents. The positive-sequence impedances are, of course, identical with those used to determine the three-phase short-circuit current in the ordinary manner.

The negative-sequence impedances are identical with the positive-sequence impedance except in the case of rotating machines, where the values are approximately 70 per cent of the positive-sequence impedances. The fact that rotating machines have different impedances to different phase sequences may be illustrated by the operation of the induction motor driven by a separate source at synchronous speed. The motor has very high impedance to voltages of positive phase sequence and very low impedance if the phase rotation of voltage is reversed, i.e., very low impedance to negative-sequence voltage.

The zero-sequence impedances are radically different from the other sequence impedances. For the transmission line the zero-sequence impedances are calculated considering all of the transmission conductors in parallel as one side of the circuit and earth as the return. The zero-sequence impedance of transformers and generators is chiefly determined by the presence or absence of a neutral connection to ground, the impedance being infinite if no neutral connection exists. This subject is discussed in greater detail subsequently.

The solution of the single-phase short-circuit problem

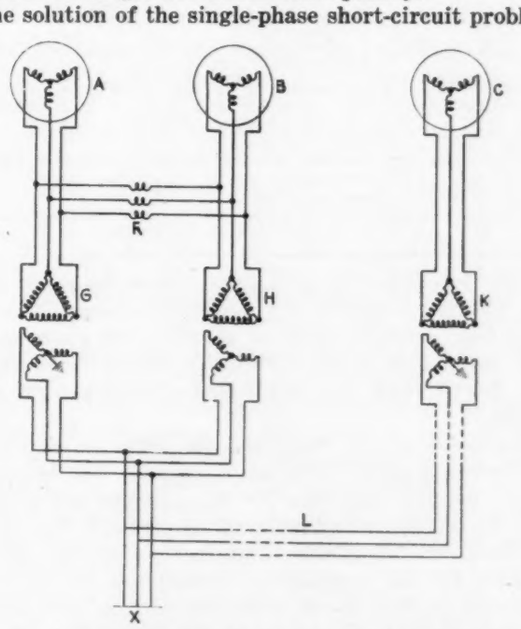


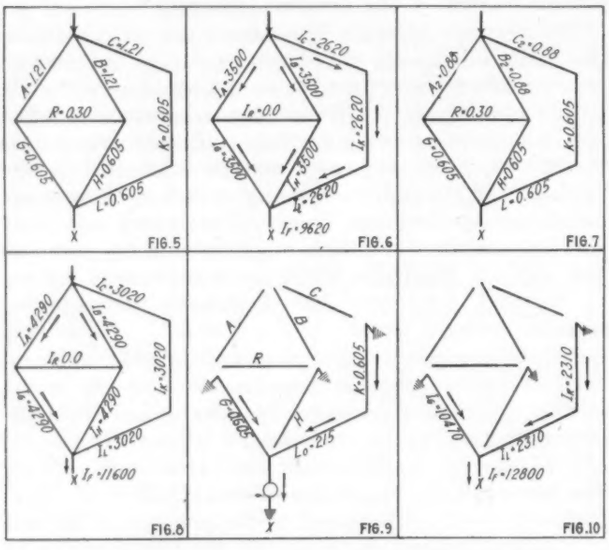
FIG. 4—WIRING DIAGRAM OF SIMPLE POWER SYSTEM

A, *B*, *C*—Generator, 20,000 kva., 11,000 volts, 20 per cent reactance.
R—Reactor, 5 per cent on 20,000 kva.
G, *H*, *K*—Transformer bank, 20,000 kva., 10 per cent reactance, 11,000/66,000 volts.
L—Transmission line, No. 4/0 copper, 6 ft. spacing, 30 miles long.
X—Point of short circuit.

involves the determination of impedance of the network at the point of short circuit for positive, negative and zero sequence, which solutions are obtained individually. The method of combining the different phase-sequence solutions to give the effect of single-phase line-to-line and single-phase line-to-ground short-circuit currents is indicated in Figs. 2 and 3 respectively.

SOLUTION ON CALCULATING BOARD

The necessary steps for computing the magnitude and distribution of single-phase short circuits will now be considered. The necessary assumptions to permit simplification in method here presented have been stated previously. The solution may conveniently be



STEPS IN THE SOLUTION OF SHORT-CIRCUIT PROBLEMS

Fig. 5—Positive-sequence network.

Branch	Nature	Ohms Reactance
A, B, C,	Generator	1.21
R	Reactor	0.30
G, H, K	Transformer	0.605
L	Transmission line	0.605

Fig. 6—Positive-sequence solution for three-phase short circuit at point *X*.

$$Z_P = 6{,}350/9{,}620 = 0.66 \text{ ohm}$$

Fig. 7—Negative-sequence network.
Fig. 8—Negative-sequence solution for short circuit at point *X*.

$$Z_N = 6{,}350/11{,}600 = 0.544 \text{ ohm}$$

Fig. 9—Zero-sequence network.
Fig. 10—Zero-sequence solution for short circuit at point *X*.

$$Z_0 = 6{,}350/12{,}800 = 0.496 \text{ ohm}$$

divided into six steps as follows: Network solution for (1) positive sequence, (2) negative sequence, (3) zero sequence; determination of short-circuit currents for (4) three-phase short circuit, (5) single-phase line-to-line short circuit, (6) single-phase line-to-neutral short circuit.

Positive-Sequence Solution.—In order to clarify the discussion, a simple illustrative example will be worked out in detail. The data for this example are given in Fig. 4; the equivalent network is given in Fig. 5, and the solution for positive sequence, which is also the solution for the symmetrical three-phase short circuit, is given in Fig. 6. A relatively simple network has been chosen so that the solution may readily be obtained analytically instead of using the calculating board.

Negative-Sequence Solution.—The network for this solution (Fig. 7) is identical with that of Fig. 5, except that the values of machine impedances have been changed. The magnitudes of negative-sequence impedances A_2, B_2 and C_2 are approximately $\sqrt{3} - 1$, or 73 per cent of the positive-sequence impedances *A*, *B* and *C*. This value of the negative-sequence impedance is derived on the assumption that the single-phase symmetrical short-circuit current at a generator terminal is equal to the symmetrical three-phase short-circuit current. This relation holds, generally, though the rate of change of main-field flux within the machines in case of short circuit will vary considerably with the type of damper winding employed. Moreover, the wave shape of the machine at time of short circuit will be considerably affected by the damper. This subject has been discussed in a recent paper, "Short Circuit of Alternating-Current Generators," by C. M. Laffoon.†

In order to get the negative-sequence solution, it is necessary only to change the impedance of the network branches representing the rotating machines and to determine the total short-circuit current and the distribution of current in the different branches. With the positive-sequence network set up on the calculating boards, it is necessary only to readjust the dials of the branches representing the generators and to take a new complete set of readings.

Zero-Sequence Network.—In general, for the zero-sequence solution it is necessary to set up a new network, which is usually very much simpler than the positive-sequence network. The method of setting up this network may be understood from a study of Fig. 11. Considering the short circuit as the source, it is necessary to include only those branches which have a neutral connection. The method of calculating the value of zero-sequence impedances of the various branches will be discussed under four principal headings, namely, transmission line, transformer, rotating machine, and neutral impedances.

Transmission Line.—The path for zero-sequence current is through all of the transmission conductors as one side of an imaginary circuit, with earth as the return. The formula for the zero-sequence reactance of a transmission line is as follows:

$$X_0 = 0.278 \log_{10} (1{,}000 \times 12 \div r_0)$$

ohms per mile at 60 cycles.

The above expression assumes that the return current flowing in the earth produces the effect of being concentrated at a point 1,000 ft. below the transmission conductors. This assumption is derived from the results of tests made for this purpose. In the above formula, r_0 is the equivalent geometric mean radius of conductor expressed in inches, which for a single round conductor is 77.9 per cent of the physical radius. The equivalent radius for n conductors is equal to the n^2 root of the product of n^2 terms, composed of the equivalent radii of each of the n conductors and the distances of each conductor to every other conductor. The equivalent radius for three similar conductors with triangular spacing reduces to the following formula:

$$R_0 = \sqrt[3]{0.779\, rd^2} \text{ for three conductors,}$$

where d is the distance between conductors and r is the physical radius of each conductor, the dimensions being expressed in inches. The zero-sequence reactance is not greatly affected by conductor size and spacing; for example: A single three-phase, 60-cycle circuit with triangular spacing has a reactance varying from 0.96 ohm for No. 0 conductor at 24-in. spacing to 0.82 ohm for No. 4/0 conductor at 120-in. spacing. For twin-

†*Journal of the A. I. E. E.*, August, 1924, page 786.

circuit lines with vertical spacing of d inches and the distance between the circuits of $2d$ in., the value of the zero-sequence reactance varies from 0.85 ohm for No. 0 conductor, with d equal to 24 in., to 0.69 ohm for No. 4/0 conductor, with d equal to 120 in. It will be noted that the number of circuits has a rather important effect on the reactance, but that the addition of a second circuit does not by any means reduce the total reactance to one-half of the value it would be for a single circuit.

In solving zero-sequence problems it is possible to carry through the calculations, considering either the total current and the total impedances of the three phases in parallel with ground as a return, or to consider the current in the individual phases and the equivalent impedance of the different phases. The latter method is preferable, and it is necessary to multiply the impedance found by the formulas given above by three in order to combine with the other impedances.

Transformers.—The impedance of two-winding transformers to zero-sequence current depends chiefly upon the type of connection employed. The network can be drawn, using the transformer impedance per phase, if the conventions as to connections given in Fig. 11 are employed.

Three-winding transformers may be treated in a similar manner. The first step is to set up the equivalent star network for the three-winding transformer. A convenient form of this method, first given by Peters and Skinner, has recently been published.‡ The conventions as to connections may now be applied to the equivalent star group of impedances for the three-winding transformer, as illustrated by items 12, 13 and 14 of Fig. 11.

Synchronous Machines.—The zero-sequence impedance of generators depends largely on the design of the machine, the chording factors, etc. In general, the impedance is usually very low and rarely will be as much as 20 per cent of the positive-sequence impedance. In the absence of definite information as to the zero-sequence impedance of the machine, it is desirable to assume the zero-sequence impedance of the machine as zero. It should perhaps be pointed out that the zero-sequence impedance of machines is not required in case the machine is connected to a transmission line through a transformer bank having delta connection on the machine side for the case of a line-to-neutral fault on the line side of the transformers.

Neutral Impedances.—Neutral impedances should be added to the zero-sequence impedance of the generator or transformer branch to which they may be connected. The equivalent impedance to be used for the solution in terms of the zero-sequence impedances in each phase is, of course, three times the actual neutral impedance.

The zero-sequence network can now be set up on a calculating board in the manner indicated in Fig. 9. Branches A, B, R and H may be neglected because of the absence of neutral connections. Branch C may also be neglected as the transformer connections do not provide a path for the flow of zero-sequence currents to the fault. Branches G, L and K, however, must be considered, because the neutral connections and the delta windings provide a path for the flow of zero-sequence current. The impedances of branches G and K are the ordinary transformer impedances as used in Figs. 5 and 7. The value of L_o—the zero sequence impedance of branch L—is computed by the formulas given above, which value is multiplied by 30 for the length of the line in miles and divided by 36 in order to reduce the impedance to 6,350 volts to neutral, and finally multiplied by 3 in order to obtain the equivalent impedance per phase, for the reasons pointed out in the last paragraph under the section discussing the transmission-line impedance. The equivalent zero-sequence impedance to the point of short circuit can now be determined and the distribution of the zero sequence current measured by the instruments as given in Fig. 10.

Three-Phase Short Circuit.—The solution for the three-phase short circuit is, of course, identical with the positive-sequence short-circuit solution which has previously been discussed (see Fig. 6).

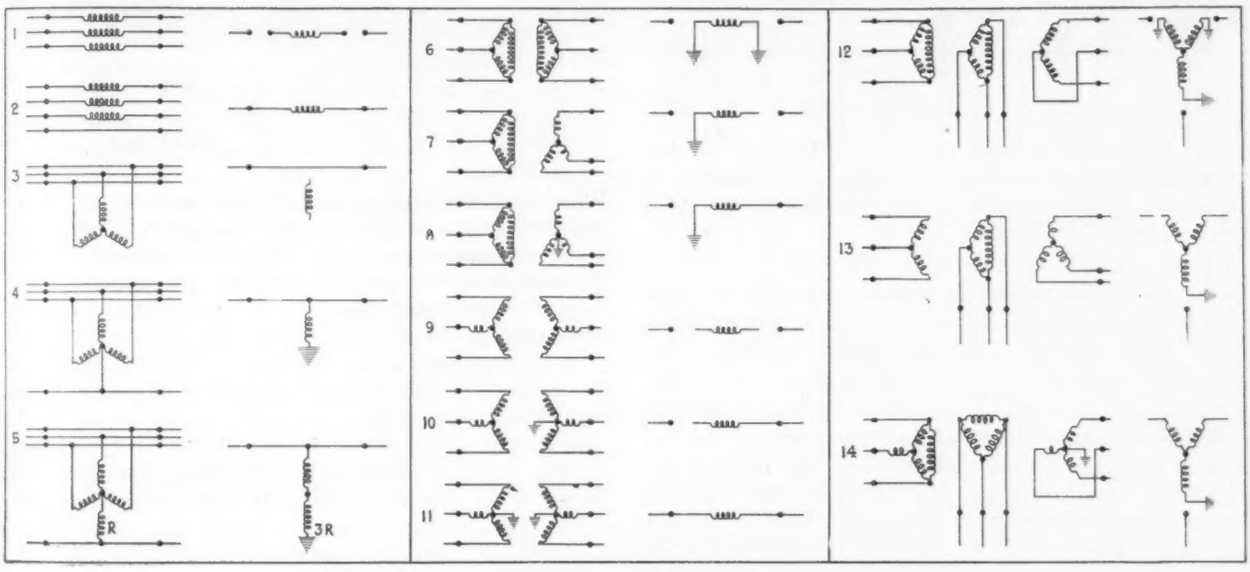


FIG. 11—METHOD OF SETTING UP ZERO-SEQUENCE NETWORK

‡"Three-Winding Transformers," by A. Boyajian, *Journal of the A. I. E. E.*, April, 1924; "Analytical Solutions of Networks," by R. D. Evans, *Electric Journal*, April, 1924.

Single-Phase Line-to-Line Short Circuit‖.—A single-phase line-to-line short-circuit solution involves the positive and negative sequence solutions previously determined, from which can be obtained the positive-sequence impedance Z_P and the negative-sequence impedance Z_N for the short circuit on phase *bc* at the point *X* in the network, Fig. 5. The positive and negative sequence currents, I_P and I_N, in phase *a* at the point of short circuit, can be determined from the following formula:

$$I_P = E_P/(Z_P + Z_N) = -I_N,$$

where E_P is line-to-neutral voltage. It may be noted that in phase *a* $I_P + I_N = 0$, as also indicated in Fig. 2.

The fault current I_F has the following value:

$$I_F = (j\sqrt{3}\,E_P)/(Z_P + Z_N).$$

The distribution of the positive and negative sequence currents in phase *a* in the various branches of the system can now be determined from the current distribution obtained from the positive and negative sequence network solutions previously made. The total current in phase *a* at any point in the network is the sum of the positive and negative sequence currents in phase *a* at that point.

The currents in phase *b* at any point can be determined from the positive and negative sequence current in phase *a* at that point by rotating the positive-sequence current through 120 deg. and the negative-sequence current through 240 deg. for the current in phase *b;* hence the respective positive and negative currents in phase *a* are numerically equal to those in the other phase as outlined under discussion of "Phase-Sequence Components."

Similarly, the current in phase *c* may be obtained by rotating the positive-sequence current in phase *a* by 240 deg. and the negative-sequence current through 120 deg.

The positive-sequence voltage at any point can be determined in the usual way, considering the positive-sequence supply voltage and subtracting the drop produced by positive-sequence currents flowing through positive-sequence impedances. The negative-sequence voltage is equal to the drop produced by negative-sequence currents flowing through negative-sequence impedances. The negative-sequence voltage is a maximum at the point of short circuit, where it is equal to the positive-sequence voltage.

In Table I are given the results of the solution of the network of Fig. 4 for a short circuit on phase *bc* at the point *X*.

TABLE I—CALCULATION OF LINE-TO-LINE SHORT CIRCUIT

Short circuit on phase *bc* at point *x* of Fig. 4

Branch	Phase	Current
Fault	*a*	$I_P + I_N = 0.0$
Fault	*b*	$a^2 I_P + aI_N = -9{,}110.0$
Fault	*c*	$aI_P + a^2 I_N = 9{,}110.0$
(*A*, *B*, *G* or *H*)	*a*	$(0.364 I_P) + 0.370 I_N = 0 + j32$
(*A*, *B*, *G* or *H*)	*b*	$a^2(0.364 I_P) + a(0.370 I_N) = -3{,}320 - j16$
(*A*, *B*, *G* or *H*)	*c*	$a(0.364 I_P) + a^2(0.370 I_N) = 3{,}320 - j16$
(*C*, *K* or *L*)	*a*	$(0.272 I_P) + 0.260 I_N = 0 - j64$
(*C*, *K* or *L*)	*b*	$a^2(0.272 I_P) + a(0.260 I_N) = -2{,}460 + j32$
(*C*, *K* or *L*)	*c*	$a(0.272 I_P) + a^2(0.260 I_N) = 2{,}460 + j32$

$I_P = -I_N = 6{,}350/(Z_P + Z_N) = 0 - j5260$

$Z_P = 0 + j0.660$ $\quad 0.364 = 3{,}500/9{,}620$ $\quad 0.272 = 2{,}620/9{,}620$ (Fig. 6)

$Z_N = 0 + j0.544$ $\quad 0.370 = 4{,}290/11{,}600$ $\quad 0.260 = 3{,}120/11{,}600$ (Fig. 8)

$a = -0.50 + j0.866$

$a^2 = -0.50 - j0.866$

Line-to-Neutral Short Circuit.—The solution of a line-to-neutral short circuit involves all three steps, namely, positive, negative and zero sequence solutions previously made. In case of a short circuit on phase *a* the positive, negative and zero sequence current at the point of short circuit and the total fault current are given by the following expression (see Fig. 3).

$$I_P = I_N = I_0 = I_F/3 = E_P/(Z_P + Z_N + Z_0).$$

The distribution of positive, negative and zero sequence current throughout the network can now be obtained from the data as to the distribution of the different sequence currents previously obtained. The total current I_a, I_b, I_c in the different phases and the neutral current I_n at any point can be obtained from the sequence components at that point, using the following equations:

$$I_a = I_P + I_N + I_0 \qquad a = -0.50 + j\,0.866$$

$$I_b = a^2 I_P + aI_N + I_0 \qquad a^2 = -0.50 - j\,0.866$$

$$I_c = aI_P + a^2 I_N + I_0 \qquad \text{(See Fig. 3.)}$$

$$I_n = 3\,I_0.$$

In the above expression I_n is the total current flowing through the neutral conductor or earth return. The positive, negative and zero sequence voltages can be obtained from the positive, negative and zero sequence currents and impedances in the manner previously described for the single-phase line-to-line short circuit.

In Table II are given the results of the solution of the network of Fig. 4 for a line-to-neutral short circuit on phase *a* at point *X*.

It will be noted from a comparison of Fig. 6 and Tables I and II that the single-phase line-to-neutral short circuit current (11,205 amp.) is nearly 17 per cent larger than the three-phase short-circuit current (9,620 amp.), while the single-phase line-to-line short-circuit current (9,110 amp.) is slightly less than the three-phase short-circuit current. It may be pointed out that grounding the neutral of transformer *H* (Fig. 4) would increase the short-circuit current in case of a single-phase fault from line to ground. The line-to-neutral short-circuit current may be as high as 150 per cent or

TABLE II—CALCULATION OF LINE-TO-NEUTRAL SHORT CIRCUIT

Short circuit on phase *a* at point *x* of Fig. 4

Branch	Phase	Current
Fault	*a*	$I_P + I_N + I_0 = 0 - j3{,}735$
Fault	*b*	$a^2 I_P + aI_N + I_0 = 0$
Fault	*c*	$aI_P + a^2 I_N + I_0 = 0$
Fault	Neutral	$3I_0 = 0 - j11{,}205$
G	*a*	$0.364 I_P + 0.370 I_N + 0.82 I_0 = 0 - j5{,}805$
G	*b*	$a^2(0.364 I_P) + a(0.370 I_N) + 0.82 I_0 = 19 - j1{,}692$
G	*c*	$a(0.364 I_P) + a^2(0.370 I_N) + 0.82 I_0 = -19 - j1{,}692$
G	Neutral	$3(0.82 I_0) = 0 - j9{,}189$
L, *K*	*a*	$0.272 I_P + 0.260 I_N + 0.18 I_0 = 0 - j2{,}659$
L, *K*	*b*	$a^2(0.272 I_P) + a(0.260 I_N) + 0.18 I_0 = -39 + j322$
L, *K*	*c*	$a(0.272 I_P) + a^2(0.260 I_N) + 0.18 I_0 = 39 + j322$
L, *K*	Neutral	$+3(0.18 I_0) = 0 + j2{,}015$
H	*a*	$0.364 I_P + 0.370 I_N = 0 - j2{,}742$
H	*b*	$a^2(0.364 I_P) + a(0.370 I_N) = 19 + j1{,}371$
H	*c*	$a(0.364 I_P) + a^2(0.370 I_N) = -19 + j1{,}371$
A, *B*	*a*	$0.364 I_P + 0.370 I_N = 0 - j2{,}742$
A, *B*	*b*	$a^2(0.364 I_P) + a(0.370 I_N) = 19 + j1{,}371$
A, *B*	*c*	$a(0.364 I_P) + a^2(0.370 I_N) = -19 + j1{,}371$
C	*a*	$0.272 I_P + 0.260 I_N = 0 - j1{,}988$
C	*b*	$a^2(0.272 I_P) + a(0.260 I_N) = -39 + j994$
C	*c*	$a(0.272 I_P) + a^2(0.260 I_N) = 39 + j994$

$I_P = I_N = I_0 = 6{,}350/Z_P + Z_N + Z_0) = -j3{,}735$

$Z_P = 0.660$ $\quad Z_N = 0.544$ $\quad Z_0 = 0.496$

$0.364 = 3{,}500/9{,}620$ $\quad 0.272 = 2{,}620/9{,}620$ (Fig. 6)

$0.370 = 4{,}290/11{,}600$ $\quad 0.260 = 3{,}120/11{,}600$ (Fig. 8)

$0.82 = 10{,}470/12{,}800$ $\quad 0.18 = 2{,}310/12{,}800$ (Fig. 10)

$a = -0.50 + j0.866$ $\quad a^2 = -0.50 - j0.866$

‖In this article the derivation of the method of employing phase-sequence quantities for the solution of single-phase short-circuit problems is not given. Reference may be made to an article on "Calculation of Single-Phase Short Circuits on Transmission Networks," by R. D. Evans, to be published in the *Electric Journal* during 1926.

more of the three-phase short-circuit current, depending upon the network connections.

Decrements.—The methods which have been described above for determining the three-phase, the single-phase line-to-line and the single-phase line-to-neutral short circuits apply directly to the determination of the instantaneous short-circuit-current values. The effect of dissymmetry and decrement can be taken into account by the use of suitable decrement curves.

A method of applying decrement curves to individual machines has been presented by Mr. Woodward in the article previously referred to. This method applies directly to three-phase short circuits, but for single-phase line-to-line short circuits it assumes that the magnitude of the instantaneous symmetrical short-circuit current is equal to the three-phase value. For the determination of the magnitude and decrement in line-to-neutral short-circuit currents it is desirable to employ a further refinement in method based on the use of phase-sequence quantities, as described below.

Since generators and motors do not generate negative or zero sequence voltages, which, as pointed out previously, arise only because of the dissymmetry produced by short circuits, it follows that only positive-sequence currents produce demagnetizing action in synchronous machines. Consequently, the decrement in machine fields depends only on the positive-sequence current. This suggests the method of determining the decrement by considering only the positive-sequence currents in the various machines connected to the system, using the decrements for three-phase short-circuit currents as described by Mr. Woodward. This method of determining the decrement from the positive-sequence components is, of course, applicable to all types of short circuits. However, since the initial symmetrical value of the single-phase line-to-line short-circuit current is shown to be but slightly less than the three-phase short-circuit current, it will be found both satisfactory and convenient to use the published decrement curves made for single-phase line-to-line short-circuit currents.

CONCLUSION

A method has been presented for solving single-phase short circuits on three-phase systems which can be carried on largely by means of the calculating board. The method may be extended, as has been done by the author, to cover a large variety of unbalanced-circuit problems. The solution of the problem of single-phase short circuits should provide a considerable amount of information to assist in the proper application of circuit breakers and relays and in the determination of the best relay settings.

Single-phase short-circuit currents are larger than the corresponding three-phase short-circuit currents, owing to the larger decrement with the latter. For grounded-neutral power systems the line-to-neutral short-circuit current may be very much more severe than the corresponding three-phase value, not only because of the difference in decrement but also because the instantaneous symmetrical value of the single-phase short-circuit current is greater. For these reasons, and in view of the relative simplicity of the method required to determine the single-phase short-circuit currents, it is recommended that all short-circuit studies include the determination of single-phase short-circuit currents for line-to-line and also for line-to-neutral faults.

Cost of Rural Electrification

Classification of Rural Conditions in Pennsylvania —Development of Curves—Determination of Cost from Curves

BY MORRIS LLEWELLYN COOKE
Director Giant Power Survey, Commonwealth of Pennsylvania

DETAILED studies of almost any character are apt to be illumined when accompanied by broad generalizations. One always feels on firmer ground in studying any part of a problem if some thought has been given to the whole. On the one hand, our survey has been at some pains to exhaust every available means of finding out what it costs or should cost to build a typical single mile of rural line. On the other hand, it seemed equally desirable to do some speculating on the sums involved in bringing about throughout the Commonwealth of Pennsylvania as a whole varying degrees of rural electrification—gaged by area and by population reached.

Before making a start on this phase of our work the problem as we saw it was placed before the executive

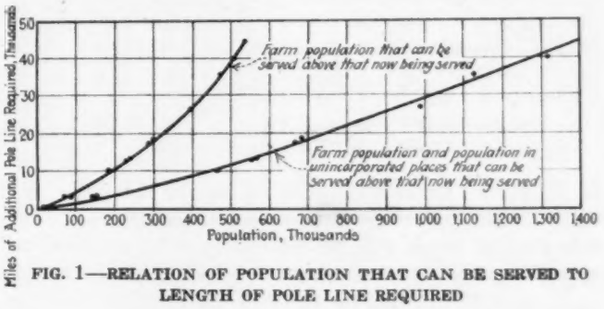

Miles of Additional Pole Line Required, Thousands
0
10
20
30
40
50
Farm population that can be served above that now being served
Farm population and population in unincorporated places that can be served above that now being served
0 100 200 300 400 500 600 700 800 900 1,000 1,100 1,200 1,300 1,400
Population, Thousands

FIG. 1—RELATION OF POPULATION THAT CAN BE SERVED TO LENGTH OF POLE LINE REQUIRED

committee of the Pennsylvania Electric Association, and there was general agreement that such a bringing together and summarizing of all available data would be helpful in estimating the money necessary for widespread rural work. We were promptly amazed at the quantity of material at our disposal and equally surprised—especially as to road mileages—as to how little had been done in the way of bringing together in one place data of a like character. This work was done for the most part by two of our staff, Perry R. Taylor, late of the Construction Corps, U.S.N., and in its later stages by George H. Morse. The results of their studies are virtually all contained in the two charts which illustrate this article. But dependence on these curves will naturally require some explanation as to how they were developed.

CLASSIFICATION OF DATA

We first determined the precise conditions that obtain in each township in Pennsylvania, as regards its area, miles of road within its borders, number of farms and the farm population, non-farm population outside of incorporated places and the number of farms having twenty or more animal units. One animal unit consists of one mature horse or cow, six hogs, eight sheep or a hundred chickens—young stock to be counted as half as much as mature animals.

The survey also mapped the areas served by electric distribution lines as distinguished from transmission lines. From this map the distance from the center of each township to the nearest electrified point and to the nearest distribution line serving two or more towns

was obtained. In 132 cases the nearest electrified point proved to be the wires of private or public central stations serving single towns. In 734 cases the nearest electrified points were in distribution lines serving two or more towns. The 132 townships are at an average distance of 4.87 miles from their nearest electrified points, and sixty-one of them are at an average distance of 10.4 miles from distribution lines serving two or more towns. The 734 townships are at an average distance of 5.77 miles from distribution lines serving two or more towns. The study includes the remaining 700 townships, each one of which is already served in whole

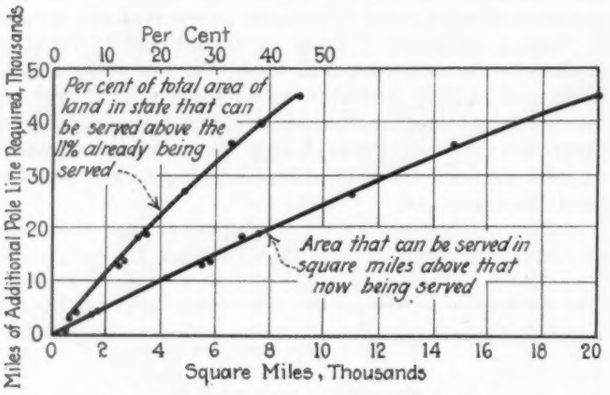

Per Cent
0 10 20 30 40 50
Per cent of total area of land in state that can be served above the 11% already being served
Area that can be served in square miles above that now being served
Miles of Additional Pole Line Required, Thousands
0 10 20 30 40 50
0 2 4 6 8 10 12 14 16 18 20
Square Miles, Thousands

FIG. 2—RELATION OF AREA THAT CAN BE SERVED TO LENGTH OF POLE LINE REQUIRED

or in part. An aggregate of 75 per cent of the area of these 700 townships is unserved and the curves cover pole line to reach the population in this area as well as in the unserved townships.

To each township was given a figure of merit independent of its distance to the nearest electrified point but dependent upon the number of farms per mile of road, the number of farms per mile of road which have twenty or more animal units, the number of cultivated acres per square mile, the productiveness of the locality, the value of farm machinery per square mile and the number of farmers owning their own farms.

DEVELOPMENT OF CURVES

The townships were then divided into groups, the initial group being composed of such townships as had the highest figures of merit, while at the same time they were closest to electrified points. Thus each succeeding group will probably have a smaller demand for energy per consumer and will be further away from an electrified point.

In the case of each township the assumption has been made, based on computation and observation, that by supplying pole line equal in length to one-half the length of the roads in a township, plus the distance of its center from the nearest electrified point, one-half of its area and three-fourths of its farm population, as well as three-fourths of its non-farm population not in incorporated places can be served. These assumptions are conservative, both because by building a line to connect a township to its nearest electrified point we shall doubtless frequently closely approach some other unelectrified township, thus reducing the allotment of line needed to serve it, and for the reason that actual experience has shown that a line which is half as long as the roads will ordinarily serve in excess of 75 per cent of the non-urban population.

The curves have been developed on the above basis. For additional pole line amounting to 10,000 to 20,000 miles the corresponding population to be served is closest to points already electrified, has the greatest potential demand for electrical energy per consumer and is distributed at closest intervals along the road. At the other extreme, where the added pole line will amount to 40,000 to 50,000 miles, are in general farms, furthest from electrified points, having the least potential demand for energy and which are most widely distributed along the roads.

It might be argued that in the comparatively few cases in which the nearest electrified point to a township is in a distribution system, municipal or private, serving a single town there is little expectation that the township could be economically served from such a small plant as would ordinarily be found in such circumstances. While this is in a sense true, the very fact that a plant exists at all in the town indicates that there is a substantial load already established waiting for early arrival of lines attached to some major distribution system such as are rapidly sending out their tentacles in all directions over the state wherever such towns exist.

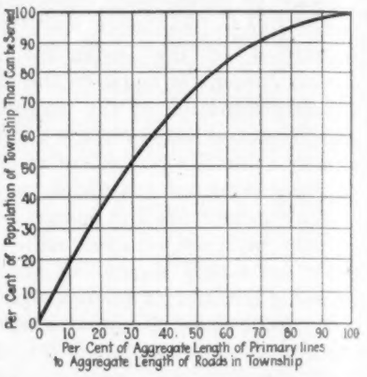

Per Cent of Population of Township That Can be Served
0 10 20 30 40 50 60 70 80 90 100
Per Cent of Aggregate Length of Primary lines to Aggregate Length of Roads in Township

FIG. 3—RELATION BETWEEN RATIO OF TOWNSHIP ROAD LENGTH TO LINE LENGTH AND POPULATION SERVED

We have had estimates for a mile of rural distribution line from $800 upward. We can assume $1,200 per mile as a good average where construction is carried on on a large scale. We then get from our curves that to reach 750,000 additional population in rural and semi-rural areas—of which 325,000 would be straight farm population—would cost 20,000 × $1,200 or, roughly, twenty-five to thirty million dollars. Such a program extended over say ten years would mean an annual expenditure of about 3 per cent of the present annual capital expenditures in Pennsylvania.

Development of Water Power in Czechoslovakia

THE water power of the Czechoslovakian Republic is estimated at 1,800,000 hp., of which only about 10 per cent is developed or in process of development. This is probably due to the fact that the bituminous coal deposits of the country are about 20,000,000,000 tons, or more than 500 years' supply. In common with other countries, however, Czechoslovakia has been led by post-war conditions to give more serious consideration to hydro-electric development, and its government has many projects under way or in embryo. Official figures issued in February show about 90,000 hp. at present under construction in various parts of the country. The most important of these developments are the Elbe power station of 22,400 hp. in the great industrial Elbe Valley district and the Fram power station of 20,000 hp. in southern Moravia. Another future development is one of 29,400 hp. near Prague in Bohemia. This will ultimately furnish electrical energy for state railroads.

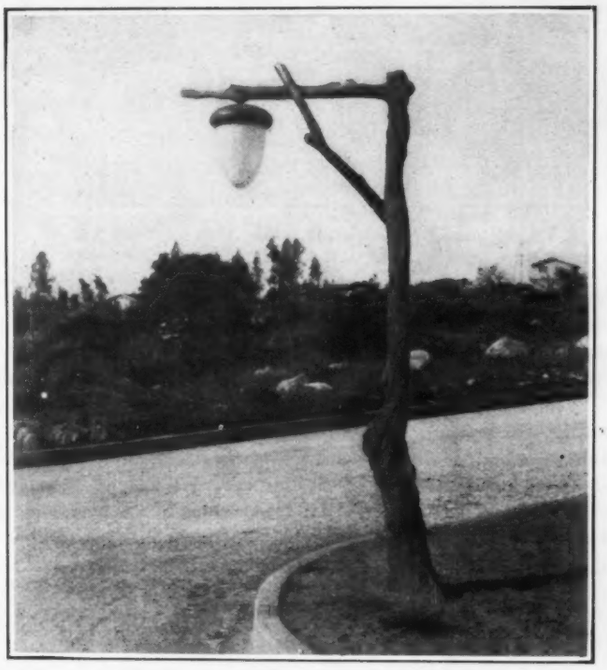
Unusual Lighting Installations

Examples of Special Designs to Meet Conditions Imposed by Architecture and Landscape in the Vicinity—Many Praiseworthy Illumination Systems and Some Freakish Attempts

By A. L. SPRING
General Electric Company, Los Angeles, Cal.

SOUTHERN CALIFORNIA offers exceptional opportunities for unusual examples of architecture, landscape and lighting. In many places the stereotyped methods of lighting are entirely unfitting and unsuited to the surroundings, and therefore something out of the ordinary is often designed to meet the special requirements.

Sierra Madre, for instance, a little city nestling at the base of the Sierra Madre Mountains, is in a setting of beautiful live oak trees. The real-estate men value an oak tree on a lot at from $500 to $1,000. Hence a beautiful subdivision in Sierra Madre with these natural ornaments called for a unique treatment. As shown in one of the accompanying illustrations, the lighting standard is an imitation in concrete of a rustic oak-tree trunk, from a bracket on which is suspended a lighting unit representing an acorn. The acorn was made by using a General Electric No. 85 globe and having a hand-hammered copper spinning made to represent the cap of the acorn. These standards and lighting units blend harmoniously with the surroundings. Series lamps rated at 2,500 lumens are used. The lighting is efficient and the standards and units are attractive.



CONCRETE STANDARD REPRESENTING THE TRUNK OF AN OAK TREE AND ACORN-TYPE LIGHTING UNIT TO BLEND WITH THE BEAUTIFUL OAK TREES AT SIERRA MADRE, CAL.

Another unique installation will be made in Montecito Park, which is in a beautiful little valley where English types of houses predominate. The designer caught the spirit of this setting and designed an old English lantern suspended from a wrought-iron bracket mounted on a redwood standard with a concrete imitation-log section as its base. Suitable plantings of ivy and shrubs will enhance the setting and will make this one of the handsomest installations to be found. One hundred and sixty-five of these will be installed, with about the same number to follow, using 2,500-lumen lamps with "IL" transformers in the bases.

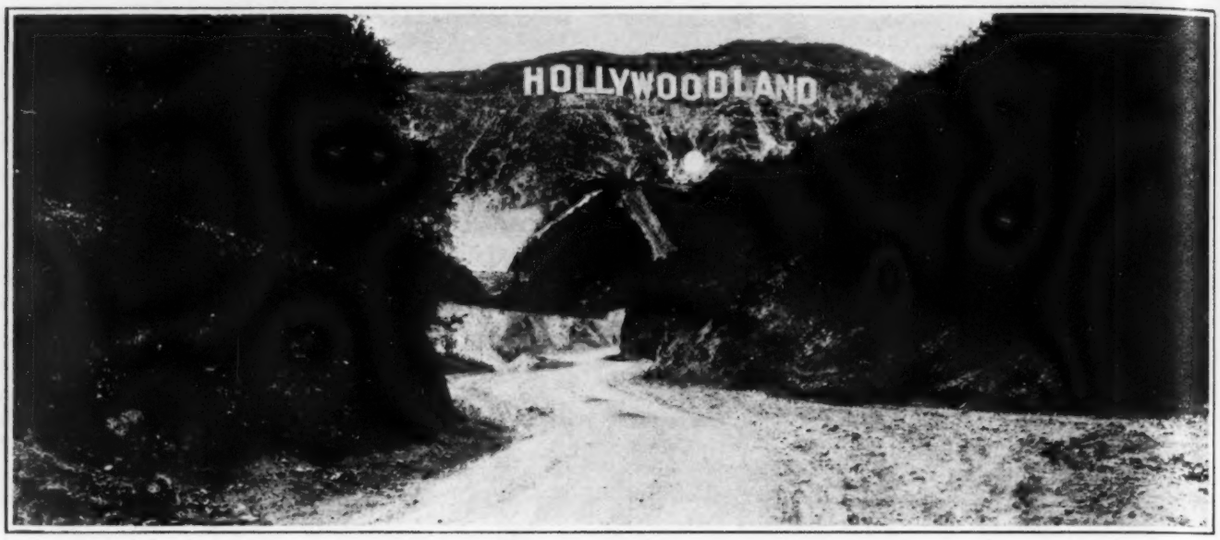
The public park at Ojai, Cal., contains some of the oldest and largest oak trees in the state. An electrical contractor of that city conceived the idea and installed the lighting system for this natural park, placing the lighting units on the branches of the trees anywhere from 20 ft. to 75 ft. above the ground. The wiring was done with "BX," and the units consist of a condulet fitting with a No. 2328 "Holophane" globe using a 100-watt, 110-volt clear "Mazda" lamp. The effect of this lighting is very artistic, and at the same time the park is sufficiently well lighted.

Marcell's Country Club, a high class café, is at the foot of the mountains several miles north of Pasadena. The proprietor of this café found that, in spite of newspaper and billboard advertising, his customers had great difficulty in finding his place of business. He installed a 24-in. General Electric searchlamp on a 75-ft. steel tower, and now the beam of light which can be seen for many miles directs his customers to the door.

The Hollywood Hospital is on Vermont Avenue, one of the streets on which the Hollywood lanterns described in a previous article are installed. Two special posts harmonizing with those on the street were manufactured by the Union Metal Manufacturing Company for the front of this building. These posts, topped with the same lantern used on the street, as shown by the accompanying illustration, are very attractive and go well with the standards on this thoroughfare.

Santa Rosa Road, better known as Christmas Tree Avenue, Altadena, Cal., is so called on account of the beautiful large cedar trees which line it on both sides for more than a mile. During the time from December 20 to New Year's Eve each year every other tree on each side is lighted from top to bottom with colored electric lights. This makes a beautiful sight and thousands of people motor to this foothill town and drive down the avenue every night during this period. This road, which is lighted on all other nights by "Novalux" highway lighting units, is fast becoming famous throughout the country owing to this unusual lighting during the holidays.

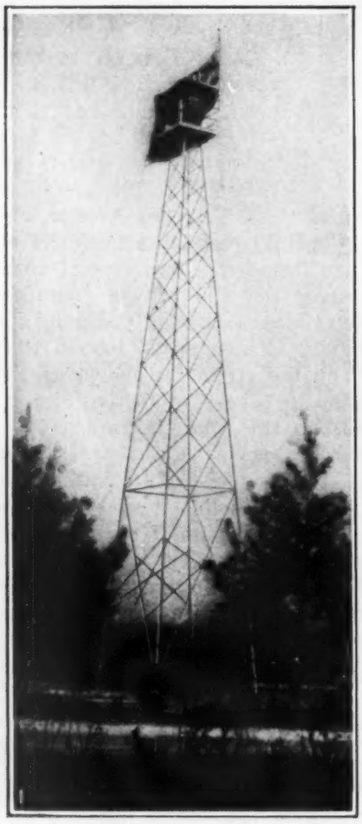
The largest electric sign in the world looks down on Hollywood and its wonderful new street-lighting system. This sign contains but one word, "Hollywoodland," the name of the real-estate subdivision on the upper part of which it is erected. Each letter is 45

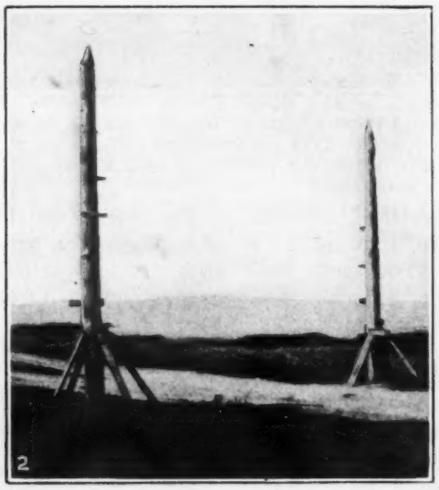


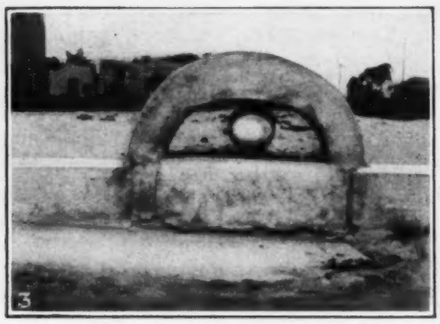
THE LARGEST SIGN IN THE WORLD ON THE HILLS OF HOLLYWOOD, CAL. THE LETTERS ARE 45 FT. HIGH AND THE SIGN IS NEARLY A QUARTER OF A MILE IN LENGTH. IT CAN BE READ FROM A DISTANCE OF 10 OR 12 MILES

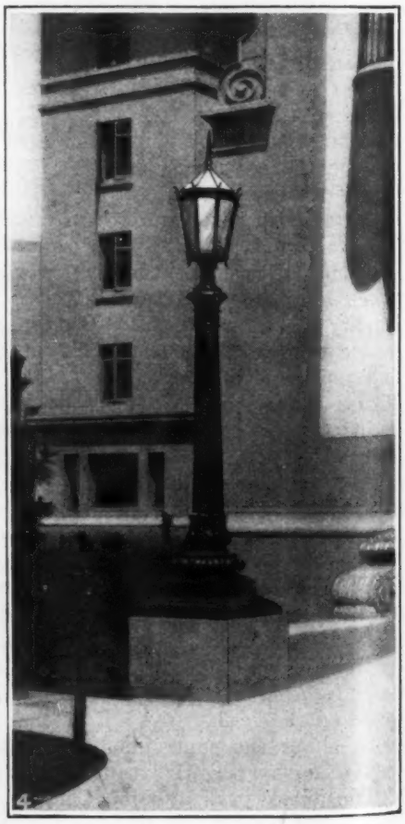
ft. high and the entire sign is nearly a quarter of a mile in length. It is 1,550 ft. above sea level and at an elevation of 900 ft. above the valley below. From this vantage point it can be read at a distance of 10 or 12 miles.

As shown by the accompanying illustration, this sign is erected on a hillside the slope of which is 45 per cent. This made the problem of installation a most difficult one, for there is no road to the site of the sign. It is reached by a bridle trail 3 miles in length or directly up the hillside. The heavy construction material used in the sign was hoisted up the hill by a tractor and block and tackle, the tractor pulling the material up as it was driven down the hill. Each great letter in this sign is supported by two or three 75-ft., 10-in.-top cedar poles set in concrete and heavily guyed four ways from large concrete "dead-men." The letters are made of unpainted galvanized iron and are fastened to 2-in. x 4-in. wooden vertical strips which are fastened to 3-in. iron pipe running horizontally between the poles.









EXAMPLES OF SPECIALLY DESIGNED LIGHTING EQUIPMENT

No. 1—Searchlamp mounted on a 65-ft. steel tower to direct motorists to a country café.

Nos. 2 and 3—Two examples of "freak" highway lighting in southern California.

No. 4—Ornamental lighting standards at building entrance to match the lantern-type street-lighting units on Vermont Avenue, Hollywood, Cal.

The sign contains 4,000 special No. 968 General Electric sign receptacles and is lighted from metal raceways by 4,000 10-watt "Mazda" lamps on 9-in. centers. The sign is on a flasher which flashes "Hollywoodland." The entire sign is turned on and off by a 10-amp. time switch which switches the current into a 10-amp. flasher, the latter in turn operating remote-control switches governing lamps on the sign. This unique scheme not only works excellently but brought about a saving of several hundred dollars. This sign was built and installed by the Electrical Products Corporation, Los Angeles, for S. H. Woodruff, owner of this subdivision, at an installed cost of $20,000. It has proved to be a most profitable investment.

"FREAK" LIGHTING

Occasionally one sees an example of "freak" lighting, but seldom in one day does he see two like those illustrated. These are within two miles of each other in a thriving little town where things are usually done differently. An enterprising tract owner in a desire to have something unique conceived the idea of lighting the roadway by means of lights set on top of the curb with concrete arches over them for protection. The accuracy of the stone-throwing boys in this vicinity soon ruined this installation. The idea, however, was evidently original with the property owner, for he has not yet been sued for infringement.

The other "freak" installation is of the lantern type. Lantern designs in street lighting are fast becoming extremely popular. This installation consists of two especially designed ornamental posts between which is suspended a 47-lumen kerosene lantern-type unit. Note the substantial appearance of the lighting posts, their broad bases and decorative pointed tops, also the ease with which the standards may be climbed to clean and trim the unit.

Letters from Our Readers

"What's the Matter with the Electric Trucks?"

To the Editor of the ELECTRICAL WORLD:

Isn't it about time for some plain speaking on the matter of the electric truck? The ELECTRICAL WORLD has for many years spoken out to the industry; several central-station men have worked and written and spoken on the subject—all well intentioned and sincere. Many favorable facts and figures have been presented. Look at the situation as a business matter. To the central-station company the electric truck is a load prospect. It can't use gasoline or other fuel; in almost every case purchased power is used. Now, then, is this load wanted or is it not? Is this great and alleged progressive industry so situated that a steady off-peak load can be dismissed as unworthy of attention? Sad to relate, such seems to be the case; I have observed it and so have many others.

Is the electric truck maker or his representative an electric booster or are horsedealers and gasoline-truck dealers helping to "do it electrically"? To see the attention given to washing machines or household refrigerators or radio, one would suppose that battery charging for trucks would command more than casual notice.

In a certain large city in Ohio a truck representative and a storage-battery representative called on the general manager of the electric light and power company, who was too busy to see them, despite assurances that these men came, not to sell to the central station, but to discuss local prospects. They were curtly told to see the power sales manager. Down in the pleasant display room they found this official among a collection of washers, flatirons, toasters and curling irons, busily engaged in laughing and chatting with a comely demonstrator for a popular vacuum cleaner. After a wait of about fifteen or twenty minutes the power sales manager walked up to inquire the cause of the visit from the truck and battery men. Instead of a cheerful, hearty welcome—the truck man spent years in central-station engineering and sales work himself and has many friends therein—these men, standing there in the showroom, had to listen to an irritable discourse on the shortcomings of the electric truck. They were distinctly told that the local utility couldn't use "electrics," had discarded an old "electric" some six years or more of age, and, furthermore, didn't propose to help sell "electrics" and had no interest therein. If people wanted to use electrics, the utility would sell the power, at standard rates. No data were available or given concerning local truck users, although there are numerous successful small fleets and one old user was found who had just scrapped a machine fourteen years old because, as he said, he would not buy power to charge it and his steam plant did not run at night. This plant makes its own power—electric—because it couldn't deal satisfactorily with the utility company.

It is true that this example is worse than is usually found, but it is seldom discovered that utility officials will accord material assistance to electric truck or battery representatives—so neutral must they be and so really indifferent to this type of load.

A large utility company owns street-railway, power and gas properties, with the city traffic very congested. Its highest officials are apparently indifferent to "electrics," but power sales officials are friendly and desirous of battery-charging load, helpful when they can be, but lack definite executive policy and leadership. All trucks for all subsidiaries are owned and operated by an auxiliary automobile property and rented to sister utilities. The management of the automobile division is apparently indifferent to "electrics," if not positively opposed to them in his own fleet, and there are fewer electric vehicles now than five years ago. The street-railway property until very recently used about a dozen two-horse trolley-repair tower wagons on maintenance, also gasoline trouble wagons. It has just replaced all horses with gasoline trucks, although routine trolley maintenance and inspection require low speed and frequent stops. Gasoline trucks, too, distribute lamps, appliances, fixtures, etc., for the electric shop which is also a department of the utility company.

Is the electrical industry big enough to see the point, or must we go on quibbling and qualifying and "passing the buck"? If I am not mistaken, the ELECTRICAL WORLD some time ago asked the question, in effect at least, "What's the matter with the electric truck?" To me the answer is high first cost, limited mileage and speed for certain work—but the greatest factor is indifference coupled with lack of real vision on the part of responsible utility executives. It is time to pass the word down the rank and file: "We want electric trucks on our lines and in our own service wherever they can reasonably be used. Talk and utilize their good points. Be a booster!"

F. F. ESPENSCHIED.

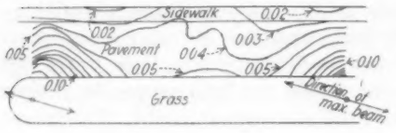
Pittsburgh, Pa.

Central Station and Industrial Practice

Traffic Signal Operation in Kalamazoo

BY EARL E. NORMAN
Superintendent Department of Public Utilities, Kalamazoo, Mich.

FORMERLY in Kalamazoo there were twelve traffic guides or "silent policemen" in the outlying districts, all connected to ordinary 120-volt service. It was necessary to send a man around to turn these off and on, and this work took two hours daily. When the illumination of the whole city was modernized, as described in the ELECTRICAL WORLD for February 28 on page 447, these signals were changed from 100-watt multiple to 1,000-lumen series and were connected to the series lines by a one-to-one ratio insulating series transformer. The operation of the traffic guides on the series circuits, besides obviating the necessity of a man spending two hours a day to turn them off and on, is much more satisfactory. Water frequently gets into the guides and with a 120-volt multiple circuit usually destroys the socket. The voltage across a 1,000-lumen 6.6-amp. series lamp is, however, only 10, which is so low that moisture does not interfere with the operation. We have had them operate entirely submerged. When partly submerged, however, the water evaporates, condenses on the upper part of the case above the lamp and then drops on the lamp, which causes it, when hot, to break.



ISOLUX DIAGRAM OF ILLUMINATION ON BOULEVARD

Two-way refractors inclosing 1,000-lumen lamps are installed in central parkway 13 ft. above ground.

The system installed is so satisfactory that we are now in process of installing a boulevard lighting system which has some unique features determined upon after experience with the previously described street-lighting system. The lamps will be placed in the central parkways, about 15 ft. above the street level. Two-way refractors inclosing 1,000-lumen lamps will be used, but instead of throwing the beam of light parallel to the street, it is thrown at an angle of about 15 deg., so that an approaching autoist is never driving toward a bright beam of light. The beams of the successive lamps are made to overlap each other, giving a very even distribution of light. In this particular instance high intensity is not needed nor even desirable, it being a purely residential street. On account of the very high efficiency of the two-way refractor, illumination is obtained on the street surface which could not be obtained even by using a 2,500-lumen lamp without a refractor. An isolux diagram of the distribution of light on this boulevard system is shown in the illustration.

Development and Use of Ground Detectors

Progress in Development and Application of Various Types of Instruments for This Service Described—Value of Ground Detection

BY E. R. STAUFFACHER
Protection Engineer Southern California Edison Company, Los Angeles, Cal.

THE use of ground detectors to indicate grounds on the overhead distribution system of the Southern California Edison Company has been an important consideration since about 1916.

This has been due to the fact that with few exceptions the distribution feeders throughout the system have been fed from substations where the distribution bus has been connected to the delta side of the station transformer bank. Because of the use of this isolated delta connection one leg of a three-phase feeder might be on the ground and there would be no positive indication in the substation. There would not be sufficient flow of current to trip out the feeder, and consequently a serious hazard would exist somewhere on the distribution feeder without the station operator's knowledge.

Furthermore, owing to the prolonged dry season during the summer months, the soil becomes almost an insulator in certain sections, and it is necessary that an unusually sensitive ground detector be employed. With but one exception the following detectors have been used in stations on the 2,300-volt or 11,000-volt bus connected to the delta side of a delta-delta or grounded star-delta connected transformer bank.

The following descriptions indicate the progress in the development and application of the various types of ground detectors on the system of this company:

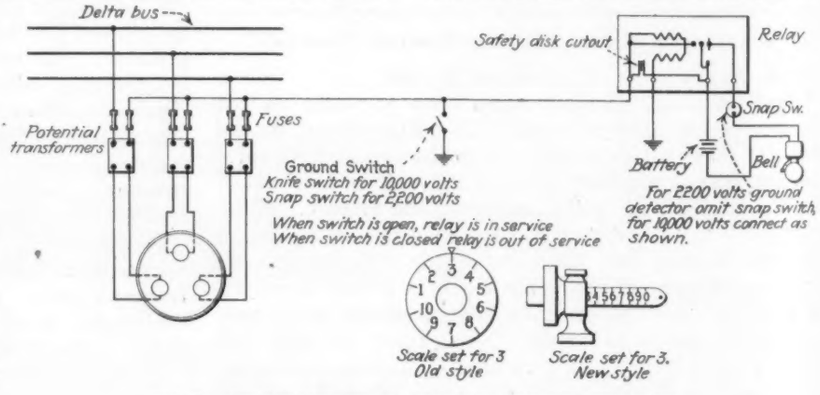

Delta bus
Safety disk cutout
Relay
Snap Sw.
Fuses
Potential transformers
Ground Switch
Knife switch for 10000 volts
Snap switch for 2200 volts
When switch is open, relay is in service
When switch is closed relay is out of service
Battery
Bell
For 2200 volts ground detector omit snap switch, for 10000 volts connect as shown.
Scale set for 3 Old style
Scale set for 3. New style

FIG. 1—TELEGRAPH RELAY TYPE OF GROUND DETECTOR

Telegraph Relay Type.—This type of ground detector consists essentially of a bank of three lamps energized by three potential transformers connected in star across the station bus. The primary neutral of the potential transformers is connected through a polarized relay to ground. The relay

contacts can be adjusted to close at any desired intensity of ground and ring an alarm bell. The connections for this type of ground detector are shown in Fig. 1. Lamp indications corresponding to various kinds of grounds are shown in Fig. 2. The character of grounds may be determined by the appearance of the lamps as shown. Wires on dry ground will be indicated as No. 1 to No. 4 and grounds in motors or transformers as in Nos. 5 and 6.

Voltmeter Type.—In this type of ground detector a single potential transformer may be connected between ground and either of two phases on the bus by means of a single-pole, double-throw switch. The secondary equipment is merely a voltmeter, indicating lamps, undervoltage relay and an alarm bell. This equipment has the disadvantage that the operator must test for grounds unless it so happens that the instrument is connected to the phase that becomes grounded. It has the further disadvantage that it requires the use of indoor equipment and indoor 11-kv. switching to test for a ground. The voltmeter type of ground detector was developed primarily for use on 11-kv. station feeder buses where the necessity for a more rugged type of detector was apparent and where the increased cost of potential transformers over 2,300-volt transformers made the use of one transformer in place of three quite desirable.

Hot-Wire Type—The hot-wire type of ground detector shown in Fig. 3 was next developed. It was so designed that the hot wires would be contracted or expanded owing to a feeder ground and the consequent unbalancing of voltage between phases. The aluminum disk would then be deflected toward one of the phase letters, *A*, *B* or *C*, shown upon the occurrence of a feeder ground, giving an indication of the magnitude of the ground and the leg which was grounded. Push-buttons were provided for testing the

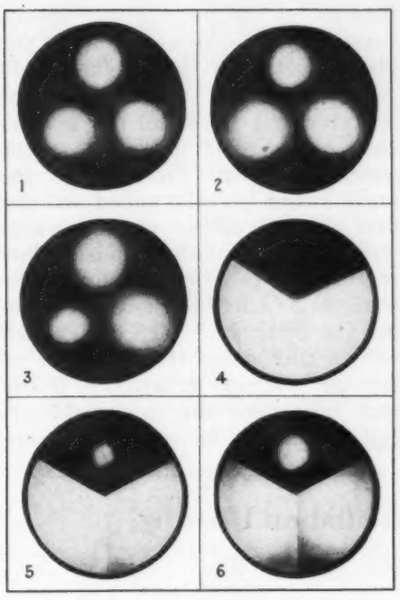


FIG. 2—LAMP INDICATIONS FOR TELEGRAPH RELAY GROUND DETECTOR

detector and a 50-cycle harmonic bell was used for an alarm. This instrument was somewhat difficult to keep in adjustment, and there was some trouble due to the hot wires becoming permanently set after the device had been in service for a few years.

Potential Type.—The connections of the potential type of ground detector which has now been adopted as standard throughout the system are shown in Fig. 4. It is made up of standard instruments and has proved quite satisfactory for both 2,300-volt and 11,000-volt service. A standard voltmeter calibrated in "per cent of ground" and a standard voltage relay are used as shown in the diagram.

Ammeter Type.—With the gradual change-over in distribution practice from feeders fed from a 2,300-volt isolated delta bus to feeders fed from a 4,000-volt grounded Y bus it was thought that the ground detector would no longer be necessary. In some cases, however, it was found that the soil was so dry that even on a grounded Y system the short circuit was not sufficient to trip out the feeder circuit and the necessity for a ground detector was apparent. This led to the type of detector shown in Fig. 5, which is being developed along the lines indicated. It will soon be applied in one of the newer stations, and it is expected that it will be satisfactory for this system of distribution. It is made up of standard instruments—an ammeter and an induction-type current relay—so it should prove rugged and reliable.

Neither the potential nor the ammeter type of ground detector indicates which phase is grounded, but simply that a ground exists on one of the outgoing feeders. It has been found in practice that there is no advantage in knowing which particular leg is grounded and that, on the other hand, there is a distinct disadvantage because it is often confusing and leads to erroneous conclusions. A patrolman will more quickly find the trouble if he simply knows that there is a ground somewhere on one of the three legs of a feeder than he will if he attempts to follow a certain designated wire which may change positions on the arm a number of times.

Experience has shown that the ground detector is a useful piece of equipment and that it not only calls attention to a hazard but also assists in pointing out minor faults which might develop into serious short circuits and grounds.

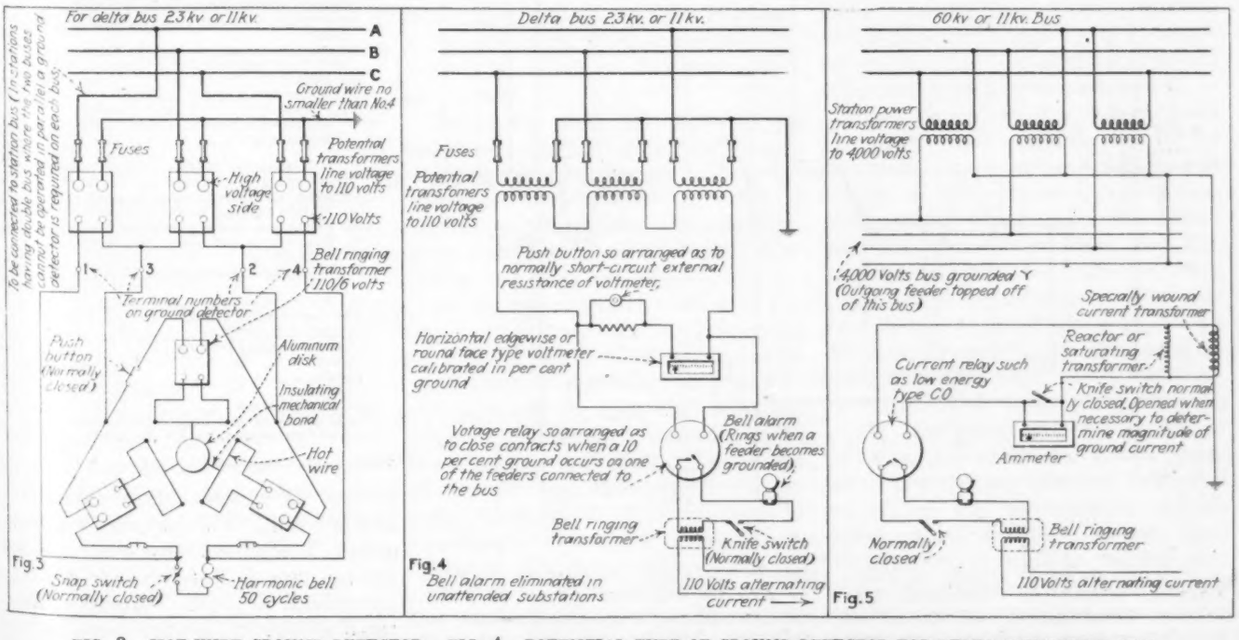

For delta bus 2.3 kv. or 11 kv.
A
B
C
Ground wire no smaller than No.4
Fuses
Potential transformers line voltage to 110 volts
High voltage side
110 Volts
Bell ringing transformer 110/6 volts
Terminal numbers on ground detector
Push button (Normally closed)
Aluminum disk
Insulating mechanical bond
Hot wire
Snap switch (Normally closed)
Harmonic bell 50 cycles
Fig. 3
Delta bus 2.3 kv. or 11 kv.
Fuses
Potential transformers line voltage to 110 volts
Push button so arranged as to normally short-circuit external resistance of voltmeter.
Horizontal edgewise or round face type voltmeter calibrated in per cent ground
Voltage relay so arranged as to close contacts when a 10 per cent ground occurs on one of the feeders connected to the bus
Bell alarm (Rings when a feeder becomes grounded)
Bell ringing transformer
Knife switch (Normally closed)
110 Volts alternating current
Fig. 4
Bell alarm eliminated in unattended substations
60 kv. or 11 kv. Bus
Station power transformers line voltage to 4000 volts
4000 Volts bus grounded Y (Outgoing feeder topped off of this bus)
Specially wound current transformer
Reactor or saturating transformer
Current relay such as low energy type CO
Knife switch normally closed. Opened when necessary to determine magnitude of ground current
Ammeter
Normally closed
Bell ringing transformer
110 Volts alternating current
Fig. 5

FIG. 3—HOT-WIRE GROUND DETECTOR. FIG. 4—POTENTIAL TYPE OF GROUND DETECTOR FOR DELTA-CONNECTED BUS.
FIG. 5—AMMETER TYPE GROUND DETECTOR FOR GROUNDED Y BUS

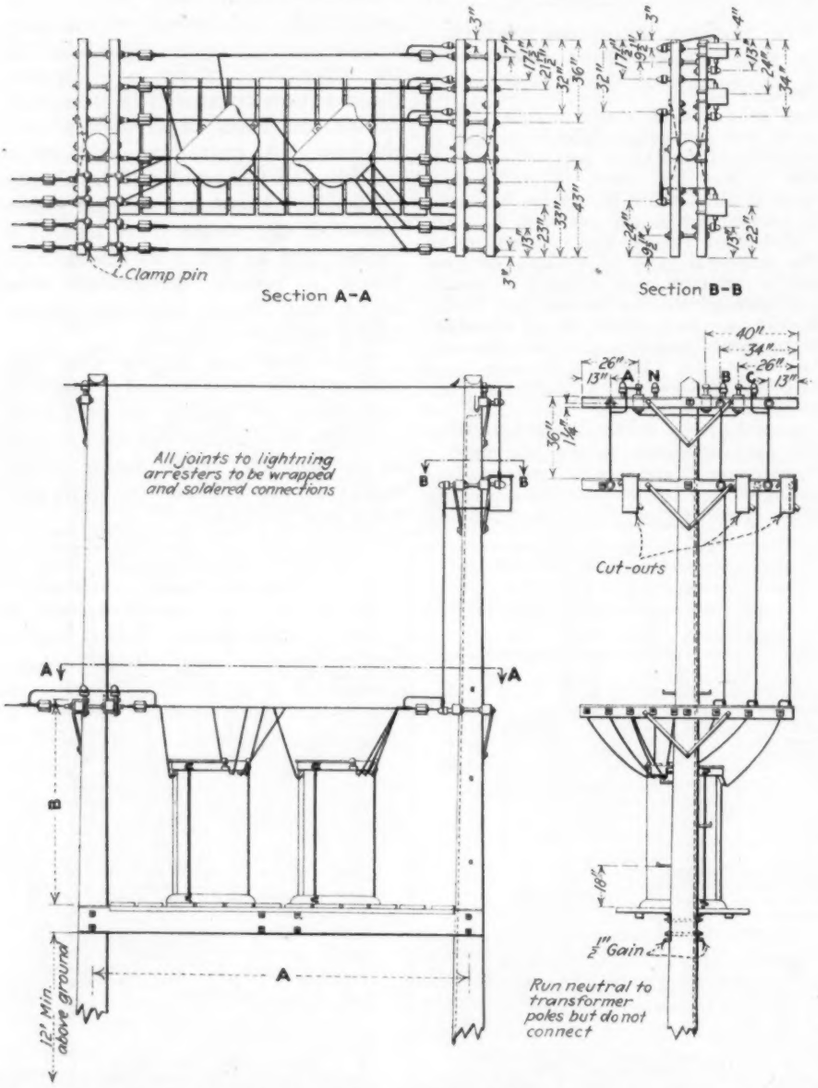
Obtaining Correct Exciter Polarity

BY J. R. DOWDELL
Plant Electrician Houston (Tex.) Lighting & Power Company, Houston

IN REVERSING the polarity of exciters by the process known as "flashing," operators must take extreme care to see that all the brushes are first raised clear of the commutator. If the polarity becomes reversed while in operation, it would cause the exciter to trip out from reverse current. Operators in the Houston Lighting & Power Company are advised not to attempt to reverse the polarity of any direct-current generators except when the plant electrician is available. In order to reverse the polarity the operator first raises all the brushes clear of the commutator. Then the generator circuit breaker and the knife switch may be closed and the field rheostat opened about one-half way. This operation establishes current in the proper direction in the shunt-field winding, thereby reversing the polarity of each pole, which will in turn cause the generator to develop correct polarity. Under such conditions the shunt-field circuit should not be left closed more than three minutes. After this period elapses the circuit breaker and knife switches should be opened and all the brushes replaced.

Then the unit is started up and the voltmeter plug placed in the receptacle of this generator to ascertain whether the voltmeter registers in the right direction. If so, the machine will be allowed to run about twenty minutes at rated voltage to ascertain if the voltage will again reverse. If this does not happen, the generator is ready for service. In doing the foregoing the operator has to be exceedingly careful to see that every one of the brushes is clear of the commutator before he attempts to flash the generator. The connections of any of the wiring should not be changed nor should the generator flash charge be left on for too long a period of time.

Auto-Transformer Installation Used by West Penn Power Company


L Clamp pin
Section A-A
Section B-B
All joints to lightning arresters to be wrapped and soldered connections
Cut-outs
Run neutral to transformer poles but do not connect
12' Min. above ground

SINCE the series of articles in ELECTRICAL WORLD on "Overhead Distribution Construction" of the West Penn Power were published some new standards have been adopted. Among them is the above installation diagram for a 4,000-volt three-phase to 2,300-volt two-phase auto-transformer installation, 37½ kva. to 150 kva. per transformer inclusive.

Diesel-Engine Operation

ONE electric light and power company in the Middle West having an installed generator capacity of 720 kw. in Diesel engines produced 2,130,540 kw.-hr. during the year 1923 at an average expense per kilowatt-hour delivered at the switchboard of 0.83 cent. The peak load for the year was 625 kw., thus producing an annual plant factor of 33.8 per cent. The company's prime-mover equipment consists of two 240-hp. type B Busch-Sulzer engines purchased in 1916. Another unit rated at 520 hp. by the same manufacturer was purchased in 1921.

DIESEL-ENGINE PLANT EXPENSE FOR 1923

(1) Installed generator capacity, kva	720
(2) Station output in kw.-hr. for twelve months ended Dec. 31, 1923	2,130,540
(3) Peak load in kw	625
(4) Annual plant factor, per cent	33.8
(5) Fuel consumption	1,618,485
(6) Average B.t.u. per lb	19,200
(7) Average pounds per kw	0.76
(8) Average price of fuel delivered, per lb., cents	0.57
(9) Operating expense per kw.-hr. delivered from switchboard in cents:	
(a) Fuel	0.4741
(b) Wages and superintendence	0.1665
(c) Water, lubrication and supplies, not including taxes, insurance and depreciation	0.1679
Total operating expense, cents	0.8085
(10) Maintenance expense per kw.-hr. delivered from switchboard in cents:	
(a) Station building and structure	0.0237
(b) Prime movers and auxiliaries	0.3248
(c) Generators and electrical equipment	0.0461
(d) Miscellaneous equipment	0.0073
Total maintenance expense, cents	0.4019
(11) Fixed charges in cents:	
Interest at 6 per cent	0.4543
Depreciation at 5 per cent	0.2839
Insurance	0.0123
Taxes	0.0843
Total fixed charges	0.8348
Total operating and maintenance expense and fixed charges per kw.-hr., cents	2.0452

The cubic feet of plant per kilowatt of installed capacity in this plant is 153. The year's operating results are given in the accompanying table.

Peculiar Joint Failures and Observations

BY D. D. CLARKE
Electrical Engineer Kansas City Power & Light Company

SOME old-type 13,200-volt three-conductor cable joints installed by the Kansas City Power & Light Company have burst at least a dozen times, but without making the circuits inoperative. The trouble was not confined to any one make of joint, but did almost invariably involve those filled with a relatively solid asphaltic compound. Examination of the burst joints and similar joints which had not yet exploded or had been made especially for test has

TWO 13,200-VOLT JOINTS THAT BURST WITHOUT DESTROYING CONDUCTORS

in virtually every case shown that where the faults were visible they extended from one conductor to sheath (sometimes from conductor to conductor), but still the conductor was not destroyed. The faults, which were examined by means of a careful dissection of chunks of compound extracted from the joints, appeared in the form of wormholes lined with oily dust or dew. In many of the faulty joints a gas having an odor somewhat like sewer gas was detected. From chemical analysis it was ascertained that such a gas could be formed by copper and hydrocarbons in the presence of an electric arc.

Extended investigation failed to disclose beyond question the cause of the faults. As a rule the joints made up like those which failed required 60,000 volts to 80,000 volts to break them down. Without any evidence to prove it, it has been tentatively assumed that air or gas in the cable is forced out into the joint compound at points where the conductor insulation is cut away and gradually makes a path to the sheath unless intercepted by another conductor, in which case a conductor-to-conductor fault is developed. Sometimes these individual bubbles arise from the jute filler in the cable. Whether the "wormholes" are caused immediately after the joint is made or develop after the cable is in operation some time is open to speculation. Apparently, however, the ultimate electrical breakdown is the result of progressive breakdown of the gas in these wormholes.

To avoid repetition of this trouble the old-type joints are being rapidly replaced by modified N. E. L. A. type joints which seal the air back into the cable. All new joints are of this type. Furthermore, precautions are taken to prevent jointers pouring compound into the joints at a lower temperature than 250 deg. F. or higher than 300 deg. F.

Handling Voltage Complaints

Detailed Description of Procedure Followed by Utica Gas & Electric Company—Method Described Has Worked Satisfactorily

FOR handling complaints of unsatisfactory light or power conditions the Utica Gas & Electric Company has established a routine method which corrects the trouble efficiently. The system up to date has worked out to the complete satisfaction of the company and of the interested customer.

When a complaint is received from any source, the meter and test department is notified over the telephone at once, the following details being given if they are available: Name, address, nature of trouble, any known cause of trouble and how long trouble has existed. The department receiving the complaint immediately follows the telephone report with a memorandum to the meter and test department, of which he sends a copy to the electrical engineering department, giving all of the facts that are known.

The meter and test department makes an investigation of the trouble on the day or the evening of the day that the report is received. If it is possible to do so, the investigation made that day is complete and conclusive. If it is not possible to conclude the investigation that day, the rest of the investigation is carried on with energy until it is concluded.

All available information which in any way can be connected with the complaint is noted. Indicating voltage readings are taken at the time of day during which the customer notes the trouble. Five readings at one-minute intervals if the service is two-wire, and ten readings, five on each side, at one-minute intervals if the service is three-wire, are taken. Additional readings are taken if necessary. All fluctuations, if any, are noted. Information regarding complaints which cannot be satisfactorily covered by indicated readings, such as the causes of flickering or high voltages, are obtained through the use of recording voltmeters.

The meter and test department then makes a written report directly to the electrical engineering department with a copy to the general superintendent of the electric department, if possible on the morning following the receipt of the complaint, or if recording voltmeters are used, as soon as the charts are received. This report covers in complete detail illumination, voltage or other conditions found and is the basis upon which further reports and recommendations by the electrical engineering department, for the elimination of trouble, are based.

Upon receipt of the report from the meter and test department the electrical engineering department makes a preliminary investigation and report, based upon the meter and test department tests, and also on records available in the electrical engineering department. The report from the electrical engineering department sums up the original complaint, the part of the test report that is of interest, the results of its own investigation that are of interest, and concludes with a statement that the trouble has been corrected, or will be corrected by certains means, within a certain time. This report is made to the commercial department, copies being sent to the general superintendent of the electric department, the superin-

tendent of transmission and distribution and the meter and test department. This preliminary report allows the representative of the commercial department to get in touch with the customer, either over the telephone or in person, explaining to him that the preliminary investigation has been made and that certain conditions have been found. The customer will by this means learn within two or three days that his complaint has been investigated, and some idea can be given him as to the length of time necessary to provide a remedy.

Upon receiving the report of conditions from the meter and test department, the electrical engineering department prepares maps and any necessary instructions for eliminating the trouble. In cases where the trouble is caused by conditions beyond the company's control—i. e., condition of interior wiring, ½-hp. motors operating on 110 volts, etc.—the correction of trouble is covered by a memorandum to the commercial department from the electrical engineering department, a copy being sent to the meter and test department, giving an outline of the causes and stating that the final report will not be issued until the customer has completed the required changes. If the preliminary tests or charts are found to be incomplete, the meter and test department asks authority to conduct further tests and investigations in order that the electrical engineering department may determine the exact reason for the trouble and the correct remedy.

When maps and other instructions are prepared, a work sheet is issued by the electrical engineering department for such changes as are necessary (giving order number or account classification) to eliminate the cause of the complaint. Work sheets marked "Voltage Complaint" are considered as emergency jobs, and upon completion of the field work the work sheet must be immediately returned to the electrical engineering department.

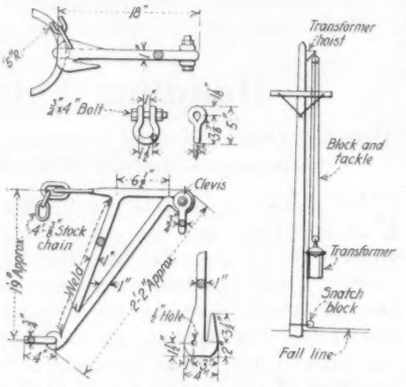
The meter and test department, upon advice from the electrical engineering department that all steps have been completed, takes additional voltage readings or charts at the "cut-in" of the customer, to be sure that the trouble has been remedied.

The electrical engineering department then makes out a final report showing that the trouble has been removed. This report is sent to the commercial department with a copy to the general superintendent of the electrical department, superintendent of transportation and distribution and meter and test department.

Upon receipt of this final report the commercial department again gets in touch with the customer and gives him such information as is thought desirable, letting him know in general that changes have been made and the trouble corrected.

Portable Transformer Hoist

A PRACTICAL lineman's tool, useful both for installing and removing pole transformers, has been designed by one of the line crew of the Pacific Light & Power Company.



EASILY CONSTRUCTED TRANSFORMER HOIST

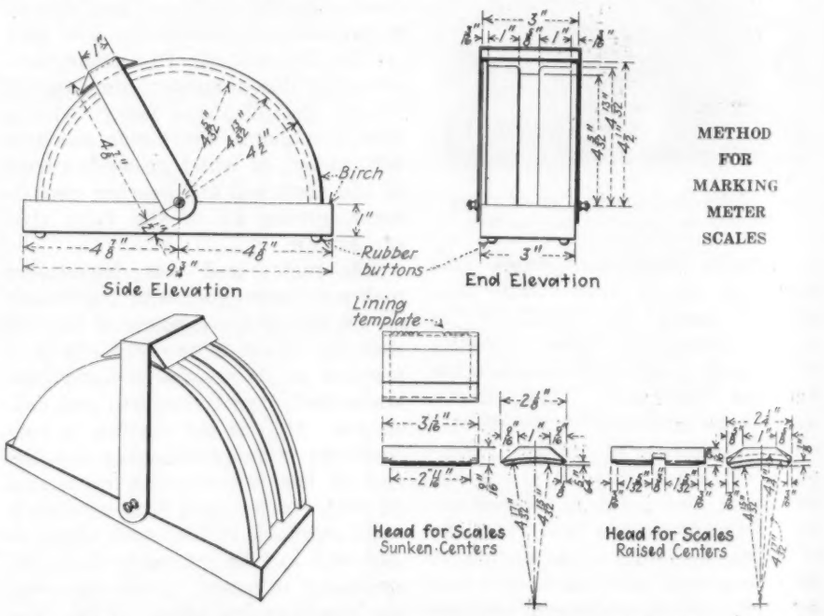
This device, which can readily be made by any one handy with blacksmith's tools, is made of 1-in. and ¾-in. round stock and a 4-ft. piece of ⅜-in. chain. One end of the 1-in. stock is first upset and then a hook is formed and a ½-in. hole is punched as shown in the sketch. The sketch shows how the remainder of the device is formed. The ¾-in. stock is shaped to form the segment of a 10-in. circle and is welded into the foot of the device so that it will partly encircle the pole when the hoist is installed for duty.

This device can be installed at any height and in any position on a pole. It is first placed in the desired location; then the free end of the chain is passed around the pole, drawn up snugly and secured in the grasp hook. The block and tackle can then be hooked in the shackle at the outer end of the hoist.

Handy Drawing Instrument for Meter Scales

BY E. O. SKOGERSON
Chief Draftsman Minneapolis General Electric Company

THE device shown in the accompanying illustration was designed for holding meter scales when putting in calibration markings and numbers. Owing to the fact that these are semi-circular, they are difficult to hold without some such device. The sketch illustrates one designed particularly for the General Electric Company's type H2 horizontal edgewise instruments, but this could be adapted to others with but little change.



METHOD FOR MARKING METER SCALES

Commercial Activities and Public Relations

Merchandise Sales in New York City $25,000,000 Annually

Conservative Estimate by Arthur Williams, Vice-President New York Edison Company, Shows Well-Developed Market for Electrical Appliances

MERCHANDISING of electrical appliances by contractors and dealers in New York City is actively supported by the New York Edison Company without that company itself actually engaging in the sale of household devices. How well this policy has worked out to produce a large volume of sales by all classes of dealers is reflected in an analysis of the replies to a questionnaire by Arthur Williams, vice-president in charge of commercial relations.

Mr. Williams' purpose in making this analysis was to ascertain the extent to which the merchandising of appliances in New York City is progressing, whether the method followed is the best under existing conditions, and if anything can be added to the joint efforts of those interested in the business to bring about more satisfactory results from the standpoint of the electrical dealers and manufacturers, the utilities and the general public.

The questionnaire covering the twelve months was sent to every contractor, dealer and manufacturer listed in the "Edison Directory"—approximately 2,500 in all. A similar questionnaire had been sent to a corresponding list in 1920. Following are the results:

A total of 363 replies were received, compared with 275 in 1920.

One hundred and eighteen reported gross sales of electrical appliances and energy-consuming devices, exclusive of wiring and permanent or portable lighting fixtures, aggregating $13,949,111, an average of $118,212 each; in 1920 eighty-five reported sales of similar articles aggregating $3,370,014, an average of $39,647.

Seventy-five reported sales of lamp fixtures, either portable or designed for permanent connection, aggregating $2,438,797, an average of $32,517 each; in 1920 seventy-two reported gross sales of $1,127,760, an average of $15,663.

One hundred and seventy-four replies gave an estimate that the sales of household appliances and fixtures for the calendar year of 1924 would aggregate $18,952,770; for 1920 154 replies estimated the gross sales for the corresponding period and purpose as $7,542,219.

Seventy-eight contractors reported electric wiring installed for the period in question aggregating $4,088,669, an average by each contractor of $52,419; in 1920 seventy-one contractors reported $3,082,405, an average of $43,814.

Ninety-seven dealers reported having electrical energy-consuming devices in stock at the present time, other than lighting fixtures, to an aggregate stock value of $1,317,072, an average of $13,578 in 1920 sixty-eight dealers reported an aggregate stock value of $677,583, an average of $9,964.

Sixty dealers in lighting fixtures reported a present stock of $785,178, an average of $13,086; in 1920 fifty-five dealers reported in stock $282,517, an average of $5,137.

Commenting on the significance of his analysis, Mr. Williams says: "Some of the largest dealers, such as the department stores, did not report on either questionnaire. I should be of the opinion that, were all included, the aggregate annual sales of appliances and fixtures would be not less than $25,000,000—exclusive of wiring.

"One of the gratifying comparative features of the two questionnaires is the extent to which merchandising shows an increase, both in aggregate volume and in the average of the individual dealers. It would seem that 'merchandising' is growing into a business which justifies the investment of large amounts of capital and most modern and intelligent merchandising effort.

"Another interesting feature is, as shown by our 'Edison Directory,' that there are now about 2,500 electrical 'points of contact' which, in one form or other, are constantly in touch with our customers and the public."

Electrical Equipment for Domestic-Science Pupils

TWENTY - FOUR 1,000 - watt single-unit hot plates have been installed in the domestic-science department of the Ripon (Wis.) high school to stimulate interest and educate the coming generation in the use of electric cooking. Provision is also made for keeping the cost of different operations. The installation was made jointly by the Wisconsin Power & Light Company and the Monarch Range Company.

ELECTRICAL EQUIPMENT OF HIGH-SCHOOL DOMESTIC-SCIENCE DEPARTMENT

A separate meter has been provided for each unit so that accurate account may be kept of energy consumption for different operations. A large chart picturing the meter dials and indicating how to read them as

well as how to calculate the cost of energy used was furnished by the power company. Controlling each hot plate is a separate service switch and pilot lamp.

The installation is serving its purpose very satisfactorily, says O. H. Offerbert of the Wisconsin Power & Light Company, and is highly commended by the instructors in charge of the high school's domestic-science department.

Meter Regulation in Texas

Law Requires Periodic Testing of Meters—State Provides Means of Adjustments on Standards—Tolerances Allowed

BY W. T. HENRICHSON*

THE majority of utilities and the people served by them will agree that the proper legislative restrictions should protect both from fraud and allow the utilities sufficient latitude to carry on their business profitably and economically.

In the State of Texas a marked advance in the direction of constructive public utility legislation was made when the Thirty-eighth Legislature passed a law empowering the state government to test and standardize the testing of meters. Meters when found incorrect will be condemned and a fine imposed upon the owner of the meter if they are used after being condemned without first making adjustments or repairs. Each meter and each day each meter is used after being condemned without adjustment constitutes a separate offense. It was the intention and desire of the Legislature to protect the law-abiding companies as well as to obtain justice for the honest consumer. The law stresses the fact that any person or company that wilfully intends to defraud by diverting electricity, water or gas in any manner so as to prevent correct registration thereof, regardless of whether by so doing the meter be made fast or slow, is guilty of misdemeanor for which a penalty is imposed. Companies which allow the meters to run fast as well as the customers who tamper with the meters to make them register less than the amount used will be prosecuted.

The Legislature has placed the duty of supervision of meters upon the Division of Weights and Measures of the Department of Markets and Warehouses. Commissioner Charles E. Baughman has established a standard meter-testing laboratory in Austin, adequately equipped with primary and secondary standards.

In most instances the utility companies visited have shown a splendid disposition to co-operate, but in some cases there is no evidence of cheerful compliance. However, the state government requires only that the meter be kept correct. How the testing shall be done is left entirely in the hands of the individual company.

The majority of public service companies in Texas realize the importance of obtaining the good will and confidence of their customers and consequently welcome the state supervision of meter testing. Some of the companies which are not equipped with accurate testing equipment and have no way to determine the accuracy of their standards when asked to explain why their meters are not correct use the excuse: "We test according to our standards and should not be held responsible if our standards are not correct, because we have no way to test them." To meet this objection the department is prepared to test and make minor adjustments on standards, free of any fee, provided the owner of the meters ships them to the state laboratory in Austin.

The department has made it a policy to insist upon periodic testing of all meters by utilities and recommends that meters be tested at least once every three or four years. Large meters should be tested oftener. Some electric companies test their large-capacity primary-demand meters as often as four times a year. The company that meets these requirements receives a letter to that effect. What constitutes correctness as required by the law has given rise to considerable controversy. It is impossible to calibrate and keep a meter absolutely correct; consequently the commissioner has established tolerances, to avoid the multitude of adjustments which might be demanded for small inaccuracies.

Settlement of a dispute over the accuracy of a meter, in the opinion of the Commissioner of the Markets and Warehouse Department, should be based on perfect measurements and not upon the upper or lower extremity of the tolerance. For example, a customer asks to have his meter tested and it is found to register 8 per cent fast. The state tolerance on that particular type of meter will be assumed to be 2 per cent.

The company makes a refund on the basis of 6 per cent discount. In such a case the Division of Weights and Measures would contend that the company was taking and claiming a commodity tolerance and was asking that the customer pay 2 per cent for service which had never been rendered. The principle of using the tolerance as a basis, and not the correct measurement, is fundamentally wrong and if permitted would set a precedent of far-reaching consequence.

*State Inspector Markets and Warehouse Department, Division of Weights and Measures and Public Weighers, Austin, Tex.

Plan for Financing Industrial Plant Electrification

TO ENCOURAGE and hasten the electrification of industrial plants which have mechanical drive or operate their own power plants the Georgia Railway & Power Company recently announced a financing plan by which these plants may purchase and install their electrical wiring and apparatus on a basis of 25 per cent cash payment when electrification is complete and the balance in deferred payments. The plan is as follows:

After interesting the prospective customer in the proposed electrification and closing a power contract with him, the company's power-sales engineers either make or get some reputable engineering firm to make the electrical lay-out of the customer's plant. When the lay-out is complete, bids are requested from the manufacturer on the electrical equipment and from the contracting firms for the wiring in and installation of this equipment.

When contracts are let to the manufacturer and the contractor, papers are drawn consisting of title-retention mortgage to the electrical equipment involved in the transaction and title-retention notes on a monthly, semi-annual or annual basis for the remaining 75 per cent of the cost of electrification. These papers are duly executed by the customer. The notes may run for any period

from one to five years, falling due at stated periods throughout the total period as the customer may elect. They are made payable to the manufacturer to cover cost of the equipment and to the contractor to cover the cost of wiring and installation of equipment, and these parties indorse the notes without recourse to the Georgia Railway & Power Company, which upon receipt of the notes reimburses the manufacturer and contractor in cash to the full face value of the notes.

This plan has now been in operation for several months, and up to date the power company has been successful in closing on this basis a number of very attractive contracts that otherwise could not have been obtained at any near future date. The extended payments carry an interest rate of only 6 per cent and as a general rule do not call for any heavy cash outlay on the part of the customer as the saving in power costs resulting from purchasing the service is usually sufficient to amortize the entire outstanding note issue in the five-year period. It might be mentioned that this plan is of course extended only to those plants whose stability and credit rating are such as to make the transaction a thoroughly sound business proposition.

Film Visualizes Electrical Progress

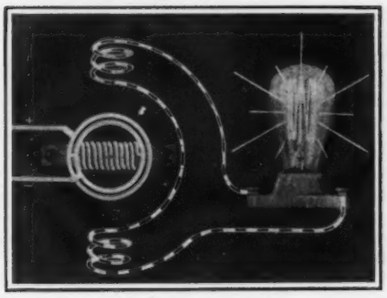
ONE of the most graphic films thus far produced to tell the story of the electric power industry to the public has lately been prepared by Stone & Webster, Boston, and is now being shown in many parts of the country to business and social organizations. This is a three-reel motion picture entitled "Power," and it combines animated drawings and photographs with unusually good effect.

Many thousands of members of Rotary Clubs, chambers of commerce, etc., are seeing it with intense interest, and its engineering accuracy has appealed to technical men generally. It combines the exposition of fundamental principles with a telling story of the dependence of modern civilization upon power in a manner that has never failed to impress the layman with the extraordinary development of steam and hydro-electric generation and utilization.

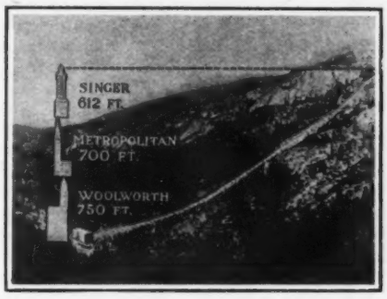
The film attempts to picture the world as it was before the eras of steam and electric power and points out the contribution which the genius who fashioned the first crude wheel made to the welfare of mankind. An animated cartoon shows the first piston pumping engine of Watt at work (1705), and Stephenson's famous locomotive, the "Rocket." An animated drawing shows the mechanical transmission of power a distance of a few score of feet followed by a contrasting series showing how electric transmission delivers power from a generator throughout a vast territory and pointing out that the distance which electricity may be transmitted is limited only by the cost of transmission lines. Maps of California, showing the Big Creek development and the Southern California Edison territory superposed on New England, follow.

The principle of alternating-current generation is graphically shown, with the effect of increasing frequency of alternations upon the steadiness of filament illumination. The power of falling water is then developed, with illustrations of striking installations in the Far West, at Keokuk and at Niagara, after which the water-power resources of the United States are depicted.

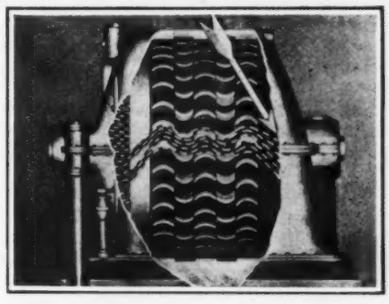
The inability of water power to do the world's work without steam's aid is clearly indicated, and the vital economic importance of the coal resources of the country and of the steam plants built and in process is set forth. A striking picture of the coal resources and annual coal consumption of the United States for power purposes is presented. An animated diagram growing from a small initial area forms a wall of coal resembling the Great Wall of China around the country and represents the annual consumption of the United States for power uses, or three-quarters of a billion tons. The film then illustrates the evolution of the steam turbine and its advance over former prime movers, with animated demonstration of the principles of steam flow through blading and the engineering application of steam generating units. A considerable section of the film pictures the design and construction of the new Weymouth plant of the Edison Electric Illuminating Company of Boston, a pioneer high-pressure installation, and finally there are charts illustrating by animated methods the rapid growth of the central-station power industry and pointing the way toward still greater triumphs in the coming decades.



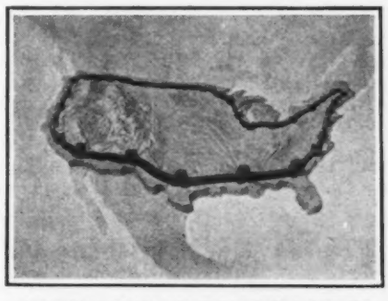
SHOWING PRINCIPLE OF ALTERNATING-CURRENT GENERATION



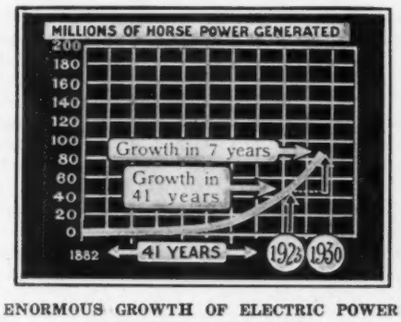
GRAPHIC ILLUSTRATION OF BIG CREEK HYDRAULIC HEAD



PRINCIPLE OF STEAM FLOW IN MODERN TURBINE IS SHOWN IN "MOVIES"



ANNUAL COAL CONSUMPTION BUILDS "CHINESE WALL" AROUND COUNTRY



ENORMOUS GROWTH OF ELECTRIC POWER INDUSTRY IS CHARTED

Digest of Electrical Literature

Hydro-Electric Development and Steam Equipment

Combustion of Pulverized, Liquid and Gaseous Fuels.—JOHN B. C. KERSHAW.—This article is essentially descriptive, with illustrations, and reviews the present state of the art. The problem of preventing the contamination of the atmosphere by fine ashes carried up with the flue gases receives attention. With low-grade coal it becomes especially serious, since the amount may be 10 to 15 per cent of the weight of fuel. Successful results of experiments with gas from coke breeze and mine waste are quoted.—*World Power*, February, 1925.

Deterioration and Spontaneous Combustion of Coal in Storage.—These six papers on this subject were presented before the Section of Gas and Fuel Chemistry at the meeting of the American Chemical Society, Ithaca, N. Y., September 8 to 13, 1924, and are abstracted at length in the issue to which credit is given below. They contain numerous charts and other data obtained as results of tests and investigations. The loss of heat values when stored coal reaches high temperatures is marked. After fifty days at 100 deg. C. it is of the order of 1,200 in 14,700 B.t.u.; at 150 deg. it becomes 3,700 B.t.u. It is of fundamental importance that the coal be free from dust or duff; every possible accession of extraneous heat must be avoided, and any interior temperature approximating 75 deg. C. should be considered as having reached the danger line. The height of piles is limited only by the increased tendency toward segregation of sizes with increase of height, though, practically, relatively shallow piles from 10 ft. to 15 ft. high are best.—*Industrial and Engineering Chemistry*, February, 1925.

Generation, Control, Switching and Protection

Grounding of the Neutral of Three-Phase Generators.—C. FELDMAN.—The shape of star-point voltages and currents is considered, a record of tests made on different machines under different loads, showing the effect of the third and higher harmonics, being included. On a 10,000-volt machine 850 volts between neutral and ground was measured. Low-resistance grounding caused trouble in the operation of telephones in the neighborhood. Eighteen oscillograph records of voltage and current under different loads and ground resistances are given.—*Tydschrift voor Electrotechniek*, January, 1925.

Theoretical and Practical Basis for Oil-Switch Design.—G. BRÜHLMANN.—The author investigates the intricate and little known phenomena which take place in a high-voltage oil circuit breaker at the instant of closing or opening. The local heating of oil, due to arcs formed, causes a very quick generation of gases. Consisting chiefly of hydrogen, these gases are inflammable and may readily be ignited. These two facts represent a dual potential danger, (1) mechanical troubles from sudden high pressures in the oil tank of the switch and (2) fire danger. A formula has been developed with which the amount of developed gas can be calculated, and practical tests seem to have checked this volume rather closely. Knowing thus what pressure has to be expected, proper provisions can be made either to relieve this pressure in a harmless way, or else to make the switch tank and cover sufficiently strong to withstand up to 12 atmospheres (175 lb. per square inch) internal pressure. The author compares an oil switch with a steam boiler. Explosions on the latter were frequent until designers learned how to build safe boilers with dependable safety valves. Similarly, experience data have been and are still being gathered pertaining to the safest design of oil switches. A great deal of practical research has yet to be made; in particular, data are needed on the lengths of arcs, the pressures developed in rupturing large energies, the temperature of the evolved gases and the influence of the frequency. Better known are those mechanical forces which result from electrodynamic action on the contacts of the oil switch, tending to open them after they were closed. From a formula given it can be seen that these forces are under short-circuit conditions of such magnitude that they amount to more than a man can overcome by hand, for which reason it is strongly recommended to equip all main generator switches in large stations with liberally designed electromagnetic control mechanisms. Closing a switch on an existing short circuit has been found to be just as dangerous as opening one, particularly in the case when the operator has a doubt and closes the switch hesitatingly—a practice which should be warned against. Assuming the breaker to be of adequate design and size, its proper function can still be counteracted by the neglect to inspect its oil and contact conditions frequently.—*Bulletin de l'Association Suisse des Electriciens*, February, 1925.

Transmission, Substations and Distribution

Distribution Systems for Electric Power in Cities.—AXEL F. ENSTRÖM.—This article is a general discussion of power distribution for cities and surrounding suburban areas, applied to Swedish conditions. The method of treatment of the problem is of general interest. The question of energy storage by electric and steam accumulators is discussed in detail.—*Teknisk Tidskrift (Swedish), Elektroteknik*, March 7, 1925.

Large Self-Cooled Transformers.—M. LAPINÉ.—Following the demand for completely self-maintained transformers the self-cooled type is receiving increasing attention. The problem is the purely mechanical one of finding a method to increase the radiating surface of transformer tanks. With deep corrugated tanks, 5,000-kva., three-phase output is probably the upper limit. Such tanks are rather delicate and must as a rule be shipped empty. Much more reliable are tubular tanks. These are suitable, according to the author, up to 7,500 kva. In America up to 10,000-kva. output has been built in such a tubular tank. Shipping clearances do not permit higher-capacity transformers to be made in tubular tanks. To overcome this the radiator tank was introduced, permitting any desired number of removable radiators to be attached to a boilerplate tank. The author shows further how essential it is to provide adequate ventilation in transformer cell so as to prevent undue overheating. [The value of this article is very seriously impaired by a large number of erroneous data given on American transformers, used as examples for tubular and radiator tanks. —EDITOR.]—*Revue Générale de l'Électricité*, March 7, 1925.

Units, Measurements and Instruments

Universal Calibration Curve for Ballistic Galvanometers.—D. P. RANDALL.—On closed circuit the throw of a ballistic galvanometer produced by a given discharge depends on the circuit resistance because of the effect of the latter on the damping. It is shown that if the sensitivity under this condition is expressed as a fraction of undamped sensitivity and the circuit resistance as a fraction of critical damping resistance a general mathematical relation is obtained which is true for all moving-coil instruments.—*Physical Review*, January, 1925.

Design of Induction-Type Watt-Hour Meters.—S. JIMBO.—The author has derived a general formula for the torque of induction-type watt-hour meters, taking into consideration the size, shape and arrangement of the essential parts of the meter. He also discusses the relation between the torque and the construction constants of the meter in the special case where the magnetic inductions are uniformly distributed under the magnetic poles. A numerical example illustrates the latter case.—*Research No. 149 of the Electrotechnical Laboratory, Tokyo, Japan.*

Investigation by Electrolytic Means of the Magnetic Leakage of Salient Poles.—A. A. AHMED.—The first part of this paper, abstracted previously in the Digest, contained a description of the method of investigating magnetic leakage by analogy. This second part takes up the experimental study of such problems as the effect of shoe thickness on leakage permeance, effect of shoe leakage on core leakage and effect of air-gap flux on leakage flux. The results are shown graphically in a number of charts.—*World Power*, February, 1925.

High-Voltage Testing.—The research laboratory of the Metropolitan-Vickers Company includes a 500-kva., 500,000-volt testing transformer used in conjunction with a sine-wave generator giving frequencies from 25 to 60 cycles. This equipment is described, also the crest voltmeter, motor-adjusted spark

gaps, rain-test apparatus and provisions for the safety of the operators. The whole control house is protected by an earthed Faraday cage, the control room itself being inclosed in glass. It is of interest to note that for calibrating the crest voltmeter the spark gap, corrected for atmospheric conditions, is stated to be used as a standard. A separate area contains the 100,000-volt equipment. — *Electrician (England)*, Feb. 6, 1925.

Illumination

Electric Light on the Farm.—A. L. POWELL.—The topics taken up are sources of power supply, wiring, lighting the house, lighting the barns and other buildings, egg production by artificial light, light and plant growth. Under the last-named head examples are given to show that while stimulation of high-priced, seasonal plants by artificial light may be very profitable, this is not true with ordinary farm products.—*Bulletin L. D. 153, Lighting Data, Edison Lamp Works.*

Motor-Car Lighting Voltage.—This is one of a series of booklets for popular distribution. It tells, in non-technical language, why there are voltage variations on motor cars, why they are objectionable and how to remedy them. —*Nela Booklet M-1, National Lamp Works of General Electric Company.*

Motors and Control

Electric Drive in the Cotton Industry.—F. B. HOLT.—In addition to a general discussion, the interesting fact is brought out that in the case of engine-driven mills serious speed fluctuations may enter between the prime mover and the line shaft. Tachograph records reproduced with the article show an engine speed constant to within 3 per cent, whereas the shaft speed pulsated over a range of almost 20 per cent, with a frequency of about 4 cycles per second, due apparently to coupled mechanical systems having definite natural frequencies of their own. Motor drive eliminates some of these elements and hence gives more uniform speed at the machines.—*Electrician (England)*, Feb. 27, 1925.

High-Speed Coal Towers at the Brooklyn Edison Company's Hudson Avenue Station.—C. D. BRAY.—*Generator Voltage Control.*—E. D. HARRINGTON. — Two towers, each of 250 tons per hour capacity with a lift of 200 ft., are used to transfer coal from barges into the bunkers. The distinctive features are described in two articles. For the hoisting motors "Ward Leonard" control is used. This permits of control of speed and direction without breaking the connection between generator and motor armature, as well as of regenerative braking almost to a standstill. Power from 2,300-volt collector rails is taken by a 700-hp., three-phase, 60-cycle cage-wound induction motor. This is direct-connected to a 500-kw., 275-volt shunt generator and a 75-kw. compound generator. The former supplies current to the armature of the 625-hp. shunt hoisting motor, the former supplies field current and current for the trolley motor.—*General Electric Review*, February, 1925.

Electrophysics, Electrochemistry and Batteries

Cathode-Ray Oscillographs. — E. WOLLNER.—A description of the high-voltage and low-voltage cathode ray oscillographs is given. The instruments have been developed for the study of high-frequency phenomena, especially in the radio technique. The author discusses several applications and attaches a list of literature published on this subject.—*Tydschrift voor Electrotechniek*, December, 1924, and January, 1925.

Properties of Neon Tubes.—B. N. GHOSE.—The current through the lamp is intermittent, the frequency being in the audible range if sufficient resistance (10 megohms) is placed in series. No current flows unless the applied voltage lies between two critical values. The light intensity is directly proportional to the current. The Osglim lamp can therefore be used to measure high resistances.—*Physical Review*, January, 1925.

Nitrates from the Air.—J. M. BRAHAM.—This article, which is illustrated, gives a history with statistics of the nitrogen industry in Norway and describes the processes there used. At present Norway produces fully 95 per cent of the nitrogen fixed by the arc process, employing therein 350,000 hp. Two types of furnace are in use, the Birkeland-Eyde and the Schönherr, the former yielding a concentration of nitric acid of about 1.25 per cent against 1.7 for the latter, but possessing operating advantages in that the furnaces are in 4,000-kw. units as against 800 kw. or 1,000 kw. The annual output of calcium nitrate is approximately 160,000 tons. Low cost of hydro-electric energy and the fact that the cost of construction has been virtually written off make it probable that the Norwegian product can continue to compete successfully with that from other sources. —*Chemical and Metallurgical Engineering*, Feb. 23, 1925.

Traction

Railway Electrifications and the Question of Power Systems. — B. WUOLLE.—The author discusses the new Kandò system (high voltaage, normal frequency, single-phase, on contact wire; frequency-changer set in locomotive cab) in comparison with present alternating-current systems. It is shown that the Kandò system possesses certain advantages which place it in an important position beside those now in use.—*Teknisk Tidskrift (Swedish), Elektroteknik*, Feb. 7, 1925.

Main-Line Railway Electrification—IV.—SIR PHILIP DAWSON and S. PARKER SMITH.—The last preceding article of this series appeared June 20, 1924. The present one deals with Scandinavia. It includes a map, a short table of privately owned electric railways in Sweden and a much fuller one giving detailed data for both the Swedish and the Norwegian State Railways, twenty-seven headings being given to the specifications for the locomotives alone, and comparative cost estimates for various possible systems. The lines now running or actually in process of electrification lie in two widely separated parts of the peninsula, the southern and more populous region and the extreme northern mineral country, the trackage in the latter being almost entirely within the Arctic Circle and comprising 476 km., or nearly half the total. Standardized features are a single-phase, 16,000-volt contact line, 15 or 16⅔ cycles, and locomotives with gears and side rods. The high cost of coal makes it economically advantageous to use water power and electrical operation.—*Engineer (England)*, Jan. 23, 1925.

Telegraphy, Telephony, Radio and Signals

Anglo-Dutch Telephone Cable.—E. F. PETRITSCH.—A sixteen-page description with twenty-eight diagrams and curves of the telephone connection between England and Holland. The line includes 156 km. of submarine cable under the North sea. The author discusses in detail the phenomena occurring on long submarine telephone cables.—*De Ingenieur*, Feb. 28, 1925.

Automatic Telephone System.—S. KAARAN.—The author describes an automatic telephone system which has been developed in Norway for Norwegian conditions. The new system is characterized by automatic line selectors and the decimal system of numbers (each selector has ten possibilities of selection). All selectors are constructed of equal parts, contributing toward a minimum of spare parts. The article gives a very complete description of the fundamental features of the new system as well as the detail construction of the individual elements. —*Teknisk Ukeblad (Norwegian)* Feb. 27 and March 6, 1925.

Triode Valves.—H. NUKIYAMA and T. KUWASHIMA.—These authors discuss the free potential of the grid and plate of the triode valve and the apparent distribution of the initial velocity of electrons. The subject is considered under the general headings of the free potential of the grid and plate, the distribution of the apparent velocity of electrons, the leakage of the triode valve and the apparent electrostatic capacity caused by the space distribution of electrons.—*Technology Reports of the Tohoku Imperial University, Sendai, Japan*, Vol. IV, No. 3.

Miscellaneous

Status of Engineers.—A report has been published by the International Labor Office, Geneva, entitled "Engineers and Chemists: Status and Employment in Industry." It was prepared by the League of Nations' committee on intellectual co-operation and deals with the human rather than the technical side of engineering. It is in English and sells for 1s. 6d. This information is taken from a strong editorial which calls attention to the serious overproduction and consequent lack of employment of engineers throughout Europe. In France and Spain the temporary closing of technical schools has been advocated. In Germany the number of technical students turned out increased from 12,000 in 1919 to 25,500 in 1921 and the increase has continued. — *Engineer (England)*, Jan. 23, 1925.

New Books

Connecting and Testing Direct-Current Machines

By F. A. Annett and A. C. Roe. New York: McGraw-Hill Book Company, Inc. 237 pages, illustrated.

One-half of this very practical book deals with the different types of windings on direct-current machines, the rewinding of machines and possible reconnections. Detailed instructions are given and good illustrations clarify the text. The second half of the book deals with tests on direct-current machines and especially with tests for troubles in the armature windings. Grounds, short circuits and other faults are discussed, and in addition to logical and convenient test methods the authors show how to correct the troubles. The book is written for practical repairmen as well as for winding experts and is sure to find a welcome.

Electrical Measuring Instruments

By C. V. Drysdale and A. C. Jolley. Part II. New York: D. Van Nostrand Company. 475 pages, illustrated.

The new volume of this encyclopedic treatise on measuring instruments reveals the thoroughness and completeness anticipated because of the same characteristics in the first volume. The second volume covers induction instruments, watt-hour meters, phase and frequency meters and auxiliary devices such as transformers and shunts. Tests and testing instruments make the book complete. It is a valuable addition to the literature of instruments and measurements, although it deals with foreign instruments very largely.

Bau Grosser Elektrizitätswerke

Second edition. By G. Klingenberg. Berlin: Julius Springer. 608 pages, 770 illustrations, 13 large plans.

This excellent book on modern layout and design of large steam-operated central stations should find general international appeal. While it is written primarily for German consumption, such a large amount of foreign practice has been included for comparative purposes that its contents are valuable to engineers of any nationality. In addition to this, the data used are the very latest; in some instances the plants mentioned have just been completed. For example, details are given of such American stations as Calumet (Chicago), Hell Gate (New York) and Colfax (Pittsburgh).

All factors entering into the design of a large station, both technical and economical, are treated in separate chapters, the simplest and the most approved method of arriving at the proper solution being given in each case. Great attention is paid to the outer appearance and the architectural balance of central and substation buildings. In the latter case the author may have gone too far, as he recommends a building for every distribution transformer of more than 30 kva. In this respect it is to be regretted that he did not elaborate more on the subject of outdoor installations, which are becoming increasingly popular even in Europe. It is strange that the author, who succeeded in obtaining such a vast amount of information on foreign power plants, does not even mention Europe's largest and most modern steam generating station at Gennevilliers (Paris). A large number of excellent and up-to-date illustrations and thirteen plan drawings contribute materially to the high value of this book.

A. P.

Ions, Electrons and Ionizing Radiations

By James A. Crowther. Fourth edition. New York: Longmans, Green & Company. 328 pages, illustrated.

Any student desiring to study this new and fascinating branch of science will find this textbook a mine of information. A complete revision of earlier editions has been made by Dr. Crowther and much new material has been added. The book treats of the fundamentals of the subject and dwells upon the experimental checks available on the theory. The quantum hypothesis is used throughout, and the scope of the contents covers gaseous conduction, ionization, rays, photo - electricity, radium and radio-active changes and the electron theory of matter.

Profitable Science in Industry

By D. T. Farnham, J. A. Hall, R. W. King and H. E. Howe. New York: Macmillan Company. 291 pages, illustrated.

The proof of the pudding lies in the eating, and this series of essays by competent writers cites convincing and fascinating examples of the way in which science influences the prosperity of industry. Science plays a constantly growing part in modern industrialism, and the publishing of feats accomplished is sure to stimulate activities along similar lines. It is notable that the authors find most of their examples in the electrical and chemical industries, but it is not surprising, for these industries have a real scientific foundation and a record of marvelous development due to their scientific building.

Strowger System of Automatic Telephony

By H. H. Harrison. London: Longmans, Green & Company. 146 pages, illustrated.

In his preface the author states that this book was primarily designed as a text for class instruction. Presumably he has in mind class instruction for automatic telephone employees, for the volume is filled with details of vital interest to them. It is less suitable as a text for electrical engineering students on account of its specialized nature, but would be useful as a reference book.

Had Figs. 18 and 55, with adequate explanations, been introduced nearer the beginning, the reader would have had a better idea of the function of the equipment as a whole and an increased interest in the detailed description of the individual parts. Where two windings are shown on one core confusion is caused by the fact that the diagrams in general give no indication of whether the magnetomotive forces are aiding or opposing. The book is fully illustrated and well written.

H. M. T.

Book Notes

The Production and Measurement of Low Pressures. By F. H. Newman. London: Ernest Benn, Ltd.

This book, by the professor of physics in the University College of the Southwest of England, Exeter, should be of great interest to manufacturers of electric lamps and wireless valves. In it is collected information which has hitherto been scattered in various periodicals. The author summarizes the various devices adopted for providing low pressures and treats at some length of pumps, in particular mercury-vapor diffusion pumps, but also of the more familiar oil pumps. Chapters are also devoted to adsorption and absorption processes, chemical, thermal and electrical processes, manometers for low gas pressures and exhaust procedure.

Costruzioni Elettromiccaniche. By E. Morelli. Three volumes, third edition. Turin: Unione Tipografico.

The third edition of this noted Italian text covers the design and application of all types of electrical machines. There will be found in it much material of value to all engineers. The practical point of view is accented in the treatment and it is written with the detail and thoroughness typical of European authors.

The Composition of Technical Papers. By H. A. Watt and P. B. McDonald. Second edition. New York: McGraw-Hill Book Company, Inc. 429 pages, illustrated.

This well-known book has been revised completely, and two new chapters on diction and professional style have been added. New articles and revised matter on letters are incorporated. The new text is a splendid practical companion for every technical writer or for those learning to write technical articles or letters.

Metallography, Chemistry and Physics of the Metals and Their Alloys. By G. Tammann. Translated from the German. Third edition. By R. C. Dean and L. G. Swenson. New York: Chemical Catalog Company, Inc. 382 pages, illustrated.

This important work on metallography is now available in a good translation. It covers metals and their alloys under the three classifications of single, binary and three-component systems. The text is based on the experimental researches of the author and is well illustrated.

An Outline of Automatic Telephony. By William Aitken. London: Ernest Benn, Ltd.

The forthcoming introduction of the Strowger director system into London and the principal provincial towns of the United Kingdom and the adaptation of this and other systems to factories and big business houses have created a widespread demand in Great Britain for an up-to-date handbook for automatic telephone operators and engineers. The standard work is William Aitken's three-volume "Automatic Telephone Systems." This well-known authority has now prepared a concise manual under the title of "An Outline of Automatic Telephony," giving a survey of all the latest information on the workings of all important automatic telephone systems.

Books Received

Die Beluchtung von Eisenbahn Personenwagen. Third edition. By Max Buttner. Berlin: Julius Springer. 207 pages, illustrated.

Hilfsbuch für die Elektrotechnik. By Dr. Karl Strecker. Tenth revised edition. Berlin: Julius Springer. 739 pages, illustrated.

Lighting Fixtures and Lighting Effects. By M. Luckiesh. New York: McGraw-Hill Book Company, Inc. 330 pages, illustrated. Price, $4.

Relativity and Common Sense. By F. M. Denton. Cambridge: University Press. New York: Macmillan Company. 279 pages, illustrated. Price, 10s. 6d.

Höhen Mathematik. Vol I. By Dr. Rudolph Rothe. Berlin: B. G. Teubner. 185 pages, illustrated.

Physik in Graphischen Darstellungen. By Felix Auerbach. Second edition. Berlin: B. G. Teubner. 257 pages, illustrated.

News of the Industry

Mitten Gives Up Fight for Control

Abandons Effort to Elect Philadelphia Electric Directors, Admitting that Stockholders Cannot Be Cajoled, but He Will Continue Conowingo Attack

ADMITTING defeat in his efforts to obtain enough proxies from stockholders in the Philadelphia Electric Company to enable him to elect a majority of the directors on the board of that company, Thomas E. Mitten of the Philadelphia Rapid Transit Company, under date of April 5, sent the following letter to Joseph B. McCall and Walter H. Johnson, respectively chairman of the board and president of the Philadelphia Electric:

"You are hereby respectfully informed that the campaign of this management to secure the proxies of the stockholders of your company has been this day discontinued and that the proxies thus far secured will not be voted in opposition to your management at your annual meeting.

"Your more than twenty thousand small stockholders were so impressed with your published assurances that you were still in control that they, over and over again, expressed a willingness to lose all that they had invested in your company, if that should be the outcome, in order to stand by you in response to your call.

"This management having itself survived with its own company against the opposition of its bankers only a few years ago, through the rallying of its own employees and stockholders—much as your employees and stockholders are now rallying to you—fully appreciates the honor tendered you in recognition of past service, as well as the greatly added responsibility which now rests upon you.

"This management hopes most sincerely that the result of this contest will make you dominant in the affairs of your company and enable you to adequately protect the interests of those stockholders who have so signally expressed their confidence in you.

"T. E. MITTEN,
"Chairman Philadelphia Rapid Transit Company."

"Note—P. R. T. must continue its fight against the Conowingo power project—for reasons already given to the commission."

Mr. Mitten's letter was reproduced by the Philadelphia Electric Company as a full-page advertisement in the Philadelphia papers of Monday, April 6, with the following comment:

"Mr. Mitten's letter is as broad-minded as it was unexpected. These two managements have always worked in harmony in the past and it is my hope that they will continue to do so in the future. WALTER H. JOHNSON,
"President the Philadelphia Electric Company System."

Thus the war between the two companies waged by circular and in the advertising columns of the newspapers comes to an end—at any rate, so far as it affects the continuance of the present management of the Philadelphia Electric Company in control, Mr. Mitten's offer to increase dividends from 8 per cent to 10 per cent should he gain the upper hand having failed to achieve its object.

Stockholders of the Philadelphia Electric Company in annual meeting on Wednesday approved the Conowingo hydro-electric project, accepted other recommendations of the board of directors and re-elected the old officers.

Joint Control of Interstate Utilities to Be Studied

Disapproval by the Maryland Public Service Commission and by Governor Ritchie of that state of the plan for joint commission control of the Conowingo project prepared by People's Counsel Miles of Maryland led to the abandonment of a conference that was to have been arranged between the Maryland and Pennsylvania commissions this week to consider the plan. The Maryland commission did not concur in Mr. Miles' belief that it has no jurisdiction over interstate utilities, and a majority of its members were not convinced of the necessity of entering a joint compact with Pennsylvania and would not therefore recommend to the Governor that a separate commission should be appointed for that purpose. Further study of the situation is to be made by the Maryland authorities. One of the "Giant Power" bills prepared by Governor Pinchot of Pennsylvania was voted out of committee in the Pennsylvania Legislature last week. This bill is designed to prepare the way for joint compacts with surrounding states when such compacts are deemed necessary.

A conference of New York, New Jersey and Pennsylvania officials over interstate electric utilities is possible. Chairman Ainey of the Pennsylvania Public Service Commission has expressed his willingness to aid in the movement favored by Governor Smith of New York for a co-operative agreement between the public service commissions of these three states.

Merger of Companies in the Niagara District Planned

A merger of the Niagara Falls Power Company, the Buffalo General Electric Company and the Niagara, Lockport & Ontario Power Company is reported as ready for consummation in the near future. The Niagara Falls Power Company is already heavily interested in the Niagara, Lockport & Ontario Power Company, and the addition of the Buffalo General Electric Company to the group will facilitate the development of a major power supply in the peninsula and lake region.

Public Ownership Defeated

Chicago Rejects Mayor's Plan—Milwaukee Against Contract—Other Verdicts

CHICAGO cast an adverse majority of approximately 100,000 in a vote of 560,000 on Tuesday of this week on the transportation ordinances favored by Mayor Dever, which provided for the purchase of the city's street-railway and elevated lines and the construction of a subway. The cost of the municipal project would have been about $621,000,000, and its rejection by so great a majority—more than its strongest opponents had ventured to predict—was a tremendous setback to public ownership theories in the metropolis of the Middle West.

On the same day Milwaukee voters rejected the "service-at-cost" contract referred to in the ELECTRICAL WORLD last week (page 733) by 44,614 to 22,341, or almost exactly two to one. This contract, which would have vested control of the Milwaukee Electric Railway & Light Company in a board of three comprising a representative of the city, a representative of the company and a neutral member, was generally regarded as a step in the direction of municipal ownership.

Superior, Wis., by popular vote overwhelmingly indorsed the City Council's abandonment of municipal ownership following a defeat in the United States Supreme Court (see ELECTRICAL WORLD for March 28, page 680).

Chippewa Falls (Wis.) voters recorded themselves, 1,897 to 1,004, in favor of purchasing a dam site on the Chippewa River and the Northern States Power Company's distribution system in order to set up a municipal plant. Last year this project, which will cost more than a million dollars, was overwhelmingly defeated.

President Gives a Free Hand to Muscle Shoals Commission

The President has given a free hand to the Muscle Shoals Commission. During the course of his first conference with the commission, on Thursday morning of this week, he is understood to have told its members to wipe the slate clean and take a fresh start in the hope that the way may be pointed to the best solution of the matter, which he feels has been delayed far longer than any of the problems involved warranted. He is said to have been emphatic in his attitude that he desires the commission to approach the problem untrammeled by any instruction

from him, although he pointed out that there is more involved than the disposition of the properties and the power. This reference is interpreted by some to mean that this property has been made the battleground for a struggle between those who favor public operation and those who favor private operation of such utilities. The conference at the White House was attended by the full commission. Its membership was printed in the ELECTRICAL WORLD last week.

Following the conference, the members went into executive session in the rooms of the military affairs committee of the House of Representatives, of which Mr. McKenzie was chairman at the close of the last session of Congress.

Functions of the Holding Company

Samuel Insull, Speaking at Public Relations Meeting at Louisville, Makes Strong Argument for Investment and Development Organizations in Central-Station Industry

IN AN address before five hundred business men and the Public Relations Section of the National Electric Light Association at Louisville on Thursday of this week Samuel Insull, president of the Commonwealth Edison Company of Chicago and internationally known public utility operator, dwelt at some length on the place of the holding company in the electric public utility business. "Most of the outstanding development of the last dozen or fifteen years," said Mr. Insull, "is due to the so-called holding companies, which have performed prodigies in spite of the handicap of that inept family name." The so-called holding company in the electric light and power business, according to Mr. Insull, is more properly an investment company or development company the primary purpose of which is to expand and energize the facilities and resources and activities of local or subsidiary companies and to broaden opportunities for safe investment. Through it high-grade electric service is placed at the command of more and still more users who would otherwise have far less efficient service or none at all. Financially speaking, this type of company is an elaboration of the "investment trust" which was long since standardized in Great Britain. As adapted to the public utility industry here, it serves the investor as the foreign "investment trust" does. Its securities enable him "to put his eggs in more than one basket even though he has only one egg." It does this by applying the insurance principle—by spreading the risk and so minimizing it; for back of the investment or "holding" company's securities lies the earning power of several companies doing a highly diversified business in diversified communities.

PROVIDING CAPITAL

Before a local company can supply service or expand to meet growing demands, Mr. Insull continued, it must have capital. The investment or "holding" company, having established a high credit rating, sees that the capital is provided, and provided at lower interest rates than the local company could get for itself. It then furnishes expert engineering service of a quality the local company could not afford. It masses the purchasing requirements of many subsidiaries and so saves money for all of them. It places at the service of the smallest operating company in its group the managerial experience and ability acquired in immensely larger fields.

This is important, said Mr. Insull, because two distinct fields of activity are represented in the administrative operation of a public utility, (1) determination of the broad technical and managerial policies, (2) supervision of the day-to-day business of the company. Operating efficiency is improved under the stimulation and guidance of the investment company's broader experience. Its assistance is still more valuable in making decisions on the larger questions of technical and managerial policy which arise infrequently but are vital when they do arise, because mistakes in them are always costly and may be disastrous. The accruing benefits of investment or "holding" company supervision, both in health and prosperity for local companies and in service to the communities concerned, are virtually all a net gain, which would be got in no other way. The process is that of making two blades of grass grow where but one grew before.

There is no element here of the investment company fattening itself at the expense of its subsidiaries, Mr. Insull maintained. On the contrary, its job is to strengthen and guide the local companies and investors in them on the road of prosperity. It applies its brains and resources to putting them in a position to supply good service at reasonable rates and thereby build up their business. In other words, to "make good" for itself and for the investors in its own securities, the investment company must first see to it that the local companies make good. In so doing the investment company of course enhances the value of its own holdings in the securities of the local companies, but at the same time it also enhances the value of all other securities of the local company whoever may own them.

The investment or "holding" company does not fix the rates charged by the local company. Speaking practically, said the speaker, its only influence upon rate making is to help the local company improve facilities, develop business and establish rate schedules on a basis that will tend toward lower rates and still more business. This influence is important especially to the customers of the local company. The only way a local company can make good is by supplying good service at reasonable rates. The supervision of the investment company is applied, and always applied, in helping the local company do exactly that. The net result is that communities served by companies that are under the supervision of an investment or "holding" company in the long run get better service at lower rates.

These holding companies are business institutions, Mr. Insull asserted, managed like other business institutions, to earn fair wages for the invested capital in return for the work done. On the one hand they bring together the accumulations of thousands of small capitalists who would have difficulty in finding safe and profitable investments each for himself, and on the other hand they put this massed capital to work in essential local community services on terms which the local enterprises could not get for themselves and then see to it that the massed capital is employed to the best advantage for all concerned.

There are 135 such companies in the United States, representing 41.3 per cent of the total capitalization of the public utility industry and 47.3 per cent of the gross revenue. The seventeen financially largest public utility groups, which embrace the more important investment companies and allied interests, together represent 43.7 per cent of the total capitalization, but they also represent 49 per cent of total investment in plant and equipment, thus indicating conservative financing. Also, and further reflecting their efficiency, with only 43.7 per cent of the total capitalization, these seventeen groups represent 48.4 per cent of the industry's total generating capacity, 49.6 per cent of the total electrical output in kilowatt-hours, 51.4 per cent of the gross income and 56.1 per cent of the population served.

A PARALLEL WITH RAILROADS

The situation of these seventeen groups is almost paralleled by that of the seventeen largest railroad systems, which together represent about half of the country's railroad business. One may wonder why there are proposals that "holding" companies in the electrical industry should be handcuffed at a time when consolidation of railroads into still larger affiliated or operating groups is being urged. Proposers of handcuffs for investment company development should be forced to face the fact that they are not striking at "exploitation of the people," at "corporate oppression," at "power trusts," or anything of the kind; they are striking primarily and especially at the populations which want the conveniences, the comforts and the all-around advantages of complete electric service and have not yet got it. These populations include the farms of the nation and nearly 40,000 towns and villages.

In concluding his address Mr. Insull expressed the opinion that the problems of extending electric service to unsupplied populations and areas, including the farms, and of enabling industry to decentralize, are more financial and economic than they are technical. The investment companies are the only agency yet developed for dealing effectively with these problems. They have made great progress in solving them, as reflected in the thousands of hamlets now enjoying full electric service which otherwise could not have any. The only hope of completing the job on a scale that will satisfy demands lies in permitting these companies to finish the work they have so well begun in this latest phase of electric light and power development in the United States.

Big Budget for New Jersey

Public Service Electric & Gas Company Plans Expenditure of $30,000,000

THE Public Service Electric & Gas Company of New Jersey has approved an electric department construction budget for 1925 which aggregates about $30,000,000 for further extension and betterment of its electric transmission and distribution system. This is in addition to approximately $24,000,000 which is being put into the first section of the Kearny generating station by the Public Service Electric Power Company, another subsidiary of the Public Service Corporation of New Jersey, and is supplementary to the large sums spent in increasing capacity of existing stations. It is estimated that for every dollar spent in providing generating capacity at least $1.50 must be spent in transmission and distribution lines and in other apparatus necessary to make the energy available to the consumer.

The 1925 construction budget is almost entirely for the extension and betterment of the company's transmission and distribution system, generating capacity having already been provided by the construction of Kearny and increase in the units in existing stations. Last year the company increased the capacity of its generating stations by almost 15 per cent, added six modern substations to the seventy then in existence and provided for the common control of the Essex, Marion and Kearny stations so that a capacity of more than 550,000 hp. can be handled from one point.

The line extensions to be made this year include an additional connection with the Philadelphia Electric Company, from which Public Service lines will carry energy to a large new substation to be built at Trenton, the Public Service's share in the enterprise to cost in the neighborhood of $2,000,000.

Development Work of Western Power Corporation Starts

Details of the plans of the Western Power Corporation to raise the storage capacity of Lake Almanor, the main storage reservoir for the hydro-electric plants of its subsidiary, the Great Western Power Company, on the Feather River in northern California, show that this storage capacity is to be increased from 300,000 acre-ft. to 1,300,000 acre-ft. by raising the present dam 46 ft. The reservoir thus created will cover an area of 45 square miles and will have a capacity in excess of all other storage reservoirs in California combined.

This construction project, which has already been started, will require the expenditure of approximately $2,000,000 over a period of two years and is the most important step in the company's program for the development of its Feather River power holdings, which constitute the largest single power development area in California. Two large hydro-electric plants are already in operation. As already published, the ten-year program contemplated involves an expenditure of $200,000,000 and the production of 1,000,000 hp. As a result of the recent consolidation with the San Joaquin Light & Power Corporation, hydro-electric energy from this development will be made available in the San Joaquin Valley through a 220-kv. tie soon to be built.

Governor Hunt Against Treaty Reservations for Arizona

Governor Hunt of Arizona has declined to transmit to the Arizona Secretary of State the recent resolution of the Legislature of that state proposing to ratify the Colorado River compact with reservations. Evidently he is intent upon placing all possible obstacles in the way of the legislation. He claims the resolution is advisory only. What may happen to the resolution apparently is of little moment as its transmission to other states would lead them to feel that they would have to adopt reservations of their own or interpret those set forth by Arizona. The task of composing all of these reservations would be endless. For that reason the general opinion seems to be that the Arizona resolution indicates no progress toward the solution of the Colorado River problem.

Bill Permitting Competition Withdrawn at Providence

The so-called United Power Company bill, which has aroused widespread discussion during the past fortnight in Rhode Island, has been withdrawn from the Rhode Island Legislature, and negotiations will shortly be undertaken between the Narragansett Electric Lighting Company of Providence and the United Electric Railways for the purchase by the former of surplus energy generated by the latter. The bill contemplated the purchase of the railway company's steam plant on Manchester Street, Providence, bestowing broad competitive powers upon the new organization. Strong opposition to the measure was exhibited by Mayor Gainer, officials and stockholders of the Narragansett company and representatives of the general public.

Two Bids for Shoals Power

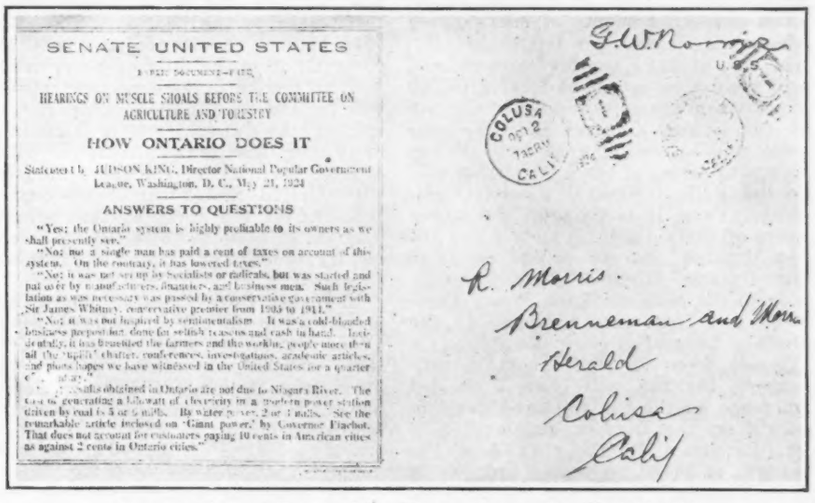
Union Carbide Company and Associated Southeastern Companies Are Probable Competitors

AT LEAST two bidders for the temporary use of power from the government plant at Muscle Shoals, soon to be available, are likely to be found—the associated Southeastern power companies and the Union Carbide Company, which on April 3 asked the Secretary of War for permission to bid, one of the conditions being a temporary lease on Nitrate Plant No. 2.

Owing to the illness of the Secretary of War, there has been some delay in advertising for bids for the temporary use of the power. The announcement by the Union Carbide Company that it desires to submit a bid was unexpected. That company is said to contemplate using virtually all of the power which will be available for the manufacture of uria in Nitrate Plant No. 2. The company is acting as host this week end to a number of government officials interested in fertilizer, who are being acquainted with the operation of the process at the company's Niagara Falls plant.

Steps are being taken looking to the construction of a transmission line connecting the end of the Wilson Dam with the switchboard at the steam plant 2 miles away. The cost involved is $500,000. Whether this work will be done with government funds or will be financed by the lessee will be the subject of negotiations. In its contract the War Department will reserve the right to make such tests as it desires before beginning to deliver power from the dam. In addition some time will probably be needed for the adjustments of the generators and of the machinery.

In connection with Muscle Shoals, attention has been drawn to the lengths to which the proponents of government ownership have gone in attempts to capitalize the situation. Not content with circulating under his frank testimony before the Senate committee, to which, of course, no objection could be made, Senator Norris, for instance, has had printed on the envelopes used for that purpose, under the heading "How-


SENATE UNITED STATES

HEARINGS ON MUSCLE SHOALS BEFORE THE COMMITTEE ON AGRICULTURE AND FORESTRY

HOW ONTARIO DOES IT

Statement by JUDSON KING, Director National Popular Government League, Washington, D. C., May 21, 1924

ANSWERS TO QUESTIONS

"Yes; the Ontario system is highly profitable to its owners as we shall presently see."

"No; not a single man has paid a cent of taxes on account of this system. On the contrary, it has lowered taxes."

"No; it was not set up by socialists or radicals, but was started and put over by manufacturers, financiers, and business men. Such legislation as was necessary was passed by a conservative government with Sir James Whitney, conservative premier from 1903 to 1914."

"No; it was not inspired by sentimentalism. It was a cold-blooded business proposition, done for selfish reasons and cash in hand. Incidentally, it has benefited the farmers and the working people more than all the 'uplift' charter, conferences, investigations, academic articles, and pious hopes we have witnessed in the United States for a quarter of a century."

[illegible] obtained in Ontario are not due to Niagara River. The cost of generating a kilowatt of electricity in a modern power station driven by coal is 5 or 6 mills. By water power, 2 or 3 mills. See the remarkable article inclosed on 'Giant power,' by Governor Plaehot. That does not account for consumers paying 10 cents in American cities as against 2 cents in Ontario cities."

G. W. Norris

U. S. S.

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SENATOR NORRIS' FRANK AIDS PUBLIC OWNERSHIP PROPAGANDA

Ontario Does It," statements made by Judson King, director of the National Popular Government League, which are presented in such a way as to constitute direct propaganda carried on at the government's expense. Senator Norris ridicules the President's commission, asserting he could write its report now.

Export Tax Will Cost Buffalo $100,000

This Is the Opinion in Niagara Region, Where Dissatisfaction Over New Canadian Policy Is Strong—Tax Likely to Retard Progress—Manitoba Against It

FAR-REACHING effects on power developments in New York and New England as well as in Canada are looked for from the tax just imposed by the Dominion government on exports of electricity. This tax will affect the consumers of all power exported to the United States except possibly those served under the fifty-year contract of the Niagara, Lockport & Ontario Power Company, which contains no clauses permitting changes in contract conditions save on amounts of energy used above the firm power contracted for. The tax, at $1.95 per horsepower-year, will yield a return of at least $100,000 a year from the power exported directly to the Buffalo General Electric Company and to the Niagara Falls Power Company, most of the latter being sold to the Buffalo General Electric Company. Thus, it is thought, the power users of Buffalo will ultimately pay the tax through charges passed on from the Ontario Hydro-Electric Commission to the Niagara Falls Power Company and from that company to the Buffalo General Electric Company.

Aside from its direct cost to consumers, the tax will have a decided influence on the contemplated developments on the Ottawa, Saguenay and St. Lawrence Rivers. At best the margin of profit on power brought in from Canada is small and the tax puts a big handicap on the financing of Canadian hydro-electric projects. Thus the economics of the situation favor a rapid development of the St. Lawrence River and possibly a revision of the Niagara Falls treaty, since power from boundary streams generated on this side would, of course, escape the tax.

Appeals to the United States government are said to have been taken by power companies concerned both to protest against the tax and to urge active negotiations on boundary treaties. In the meantime the whole power program of utilities in the northern tier of New York State and in New England will be delayed and left without a definite basis for building. Unless boundary or Canadian power becomes available it will be necessary to construct many new steam stations to supply the power demands. Much dissatisfaction is expressed over the whole situation by American power interests, and the consensus of opinion as expressed in the Niagara district is hat the Canadian government has made a mistake from its own national standpoint as well as from the standpoint of American utilities.

Another Canadian View

Further light on the attitude of Canadian public men upon the question of power exportation is shed by an utterance of H. H. Stevens, Minister of Trade and Commerce in the last Canadian government and a prominent leader in the Conservative party, who, speaking in the House of Commons a few days ago, said:

"It should be carefully guarded as a useful implement for Canadians. I am not saying that we should immediately cut off the permission to sell export power, but if any of it is to be exported, it should be done on the basis that if we have any excess that we are not using, we will lend this power under license for a year to the people on the other side, but we should not part with the control. It is the duty of every member to recognize and realize this—it will fix the limitation of expansion of industry in Canada, and it is nothing more nor less than placing a noose around the neck of Canadian industry with United States capitalists on the free end of the rope, so that at any moment suitable to them the noose can be tightened and Canadian industry strangled."

In answer to the question, "If we are permitted to impose an export duty of $1.95 per horsepower per annum, is there anything to hinder this Parliament from making it $20 per horsepower?" Mr. Stevens said: "Nothing in the world."

Two Provinces Favor Export

The Manitoba government has forwarded to the Canadian federal government a protest against the proposed export duty on electric power. It is understood that the Manitoba government takes the stand that the imposition of the duty at this time, when negotiations are proceeding for the sale of power to certain districts in North Dakota and Minnesota, is placing a prohibitive bar against development of the provincial hydro-electric system.

The New Brunswick government, which has made plans for the development of Grand Falls on the St. John River, evidently does not believe that the Dominion government will attempt to prohibit the export of hydro-electric power. The big consumer of Grand Falls power will be the Fraser Brothers, Ltd. That company, the largest in New Brunswick, is erecting a paper mill on the Maine side of St. John River, and it is understood that the legal advisers of Fraser Brothers and the New Brunswick Hydro-Electric Commission take the ground that while the Dominion government may impose an export tax, an export embargo would be *ultra vires* of the Dominion Parliament, an interference with contractual and civil rights, jurisdiction over which is vested in the Provincial legislatures, and that any of the provinces could resist a tax designed to prohibit exports rather than to raise a reasonable revenue.

With one dissenting vote the Trades and Labor Council of Montreal at its last meeting adopted a resolution favoring the export of hydro-electric power and calling upon the Dominion government to pass such legislation as may be necessary to assure the development of the Carillon Falls on the Ottawa River.

Licenses for Coming Year

Licenses for the export of 147,725 kw. of electrical energy from Canada during the new fiscal year beginning April 1 have been issued by the Department of Trade and Commerce. The following Canadian companies have been licensed: The Maine & New Brunswick Power Company, 2,500 kw.; La Compagnie d'Eclairage de Napierville, Quebec, 500 kw.; Cedars Rapids Manufacturing & Power Company, 75,000 kw.; Ontario & Minnesota Power Company, 3,000 kw.; International Railway Company, Niagara Falls, 200 kw.; Canadian Niagara Power Company, Niagara Falls, 45,000 kw.; Canadian Niagara Power Company (power returnable on demand), 20,000 kw. The last named is a new permit, all the others being renewed permits.

For western Canada the following licenses have been issued: West Kootenay Power & Light Company, Rossland, B. C., 1,500 kw.; International Electric Company, Stewart, B. C., 25 kw. The latter is a new license and the former a reissue.

The export tax on power included in this year's budget will apply on power exported under these licenses.

Federal Government Loses Suit Over Lamp Monopoly

The United States government's suit for an injunction against the General Electric Company, the Westinghouse Electric & Manufacturing Company and the Westinghouse Lamp Company for alleged violation of the Sherman anti-trust laws has been dismissed by Federal Judge Westenhaver at Cleveland.

It was charged that the companies control the retail price of a certain make of electric bulb. Attorneys for the companies contended that the General Electric possesses the patent rights to make the bulbs and that the Westinghouse companies manufactured them as lessees and distributed them as directed by the General Electric. Judge Westenhaver held that this practice did not violate the anti-trust laws.

A. I. E. E. Regional Convention at Swampscott, Mass.

The second regional convention of the First (Northeastern) District of the American Institute of Electrical Engineers will be held at the New Ocean House, Swampscott, Mass., May 7, 8 and 9. The Lynn Section will act as host assisted by the Boston Section. The technical papers will deal with such subjects as high-voltage power cable, tap changing under load, transmission problems, electrical measurements, and engineering and industrial education. Most of the papers will be by well-known engineers, but some will be presented by younger authors in competition for the regional and national first-paper prizes.

Metermen Discuss Problems

Section of Empire State Gas and Electric Association Meets at Utica N. Y.

AN UNUSUALLY interesting group of papers on the maintenance of working standards and demand meters, meter department records, instrument transformers, relay maintenance and the temperature compensation of watt-hour meters was presented at the annual meeting of the Electric Meter Section of the Empire State Gas and Electric Association, held in Utica, N. Y., April 6-7. The high caliber of the program was due in a great part to the able leadership of E. A. Le Fever of the Buffalo General Electric Company, chairman of the section.

E. P. Peck, general superintendent of the Utica Gas & Electric Company, in welcoming the delegates, pointed out that every meterman should develop the art of observation, analysis and drawing conclusions and said that there is no limit to the things with which the meterman and tester should be familiar.

In a paper on the maintenance of working standards, H. J. Klumb of the Rochester Gas & Electric Company described the test apparatus and facilities that every utility company should have. He maintained that rotating standards should be checked once a week for standards in constant use and said that his company checked its rotating standards every day the standard was used.

Demand-meter maintenance was discussed by G. B. Teevan of the Brooklyn Edison Company, who described the various types of demand meters on the market and outlined the methods of reading, inspecting and repairing used by the Brooklyn Edison Company.

In the discussion following these papers, D. P. Burleigh of the General Electric Company criticised companies which allow their men to use the 5-amp. coil of rotating standards for light-load adjustment, when the 1-amp. coil should be used. He also pointed out that it was very important to keep all checks on rotating standards for a number of years as this helps to solve many problems.

At the afternoon session C. L. Casler of the Syracuse Lighting Company discussed various systems of meter department records. He detailed the system used by the Syracuse company and also that employed by the Adirondack Power & Light Corporation.

Scott Lynn of the Canadian Sangamo Electric Company gave a valuable and highly technical paper on the subject of instrument transformers. He dealt at length with the two-stage type of current transformer, pointing out its applications, the result that can be obtained and methods of checking. A. J. Allen of the United Electric & Power Company said that he felt the two-stage current transformer was particularly good for 400, 600 and 800 amp., as it gives a current transformer with a single turn that has the reliability of the ordinary single-stage multi-turn transformer.

N. B. Phillips of the Buffalo General Electric Company gave an admirable paper on meter installation practice. For power work his company has designed three standard panels that are used entirely for this type of work. Everything connected with the panel is supplied by the consumer with the exception of the meters, testing block and instrument transformers.

H. W. Bell of the Empire State Gas and Electric Association spoke profitably on the importance of electric metermen adopting an effectual public relations policy. He stressed the importance of their work and contended that every department, regardless of its particular nature, should consider itself responsible in a large measure for the promotion of good public relations.

Induction-Type Relays

At the Tuesday morning session W. J. Healey of the Westinghouse Electric & Manufacturing Company discussed the principles of operation and commercial application of induction-type relays. A paper on relay maintenance by W. Jordan of the Westchester Lighting Company was then presented. This paper was abstracted in the ELECTRICAL WORLD for January 17, page 153, having been originally presented before the Electric Section of the association.

The discussion on relay maintenance ranged around the methods for testing relays—that is, whether to use resistance loading or phantom loading. It was the consensus of opinion that more reliable results could be obtained with resistance loading. If care be taken, phantom load testing can be made very reliable, but this requires a well-designed transformer and its use always under the same conditions.

W. D. Wilkison of the Utica Gas & Electric Company outlined the procedure for relay maintenance employed by his company, concluding with an analysis of relay operations of the Utica system for 1923 and 1924.

W. S. Davis of the Public Service Electric & Gas Company of New Jersey spoke on the meterman and his opportunities. He said that in the United States there are approximately ten thousand engineers engaged in the meter branch of the industry. It is on this group that the revenue of all the central-station companies depends.

Two papers were presented on temperature compensation of induction-type watt-hour meters. I. F. Kinnard of the General Electric Company described the work that is being done by that company. A "thermalloy" device is used as a magnetic shunt to the main magnets. This shunt consists of two parts, each part having different characteristics. One section corrects for the temperature error of the meter from 25 deg. C. down to — 14 deg. C., while the other corrects for the temperature error from 25 deg. C. to 55 deg. C. Within two months these compensating devices will be on all meters shipped by the General Electric Company. R. H. Lydon of the Duncan Electric Company described its work on temperature compensation.

A. J. Allen, the United Electric Light & Power Company, was elected chairman of the Electric Meter Section for the coming year, and W. D. Wilkison of the Utica Gas & Electric Company was elected vice-chairman.

Pinchot's Bills Lose Out

Pennsylvania Legislature "Indefinitely Postpones" Action on "Giant Power"

GOVERNOR PINCHOT'S "Giant Power" plan met with a reverse at the hands of the Pennsylvania Legislature this week when the House manufactures committee decided to "indefinitely postpone" action on the fifteen bills recommended by the Giant Power Survey Board. The committee voted, however, to continue the board another two years.

Notable Inspection Trips for N. E. L. A. Delegates

Plans for the forty-eighth annual convention of the National Electric Light Association, to be held in San Francisco on June 15-19, are rapidly developing. From present indications there will be approximately five thousand visitors in attendance, of whom two thousand or more will come from east of the Mississippi River. On April 1 hotel reservations for Eastern delegates were in excess of five hundred and reservations were ready to close on the four special trains which will carry visitors from various sections of the East to the Pacific Coast.

Present plans include a series of inspection trips to many important plants. Those coming through the Pacific Southwest will visit the two new steam stations in Los Angeles—the 70,000-kw. Long Beach No. 2 plant of the Southern California Edison Company and the 30,000-kw. Seal Beach plant of the Los Angeles Gas & Electric Corporation. A trip also is planned to the Big Creek-San Joaquin project of the Southern California Edison Company, known as "the world's largest engineering project," where 1,300,000 hp. is in the course of development in a chain of eighteen hydro plants.

The San Joaquin Light & Power Corporation will conduct a trip over its Crane Valley system of plants, including a visit to its Kings River project, where work is under way on the Balch plant, containing the highest-head impulse turbines in North America. This station will operate under a head of 2,470 ft. Trips will be made to the Pit River project of the Pacific Gas & Electric Company, where construction is progressing on two plants, Pit No. 3 and Pit No. 4, having an aggregate capacity of 200,000 kva. Pit No. 1 plant, with an installed capacity of 70,000 kw., will also be visited. Delegates will have an opportunity of inspecting also the Spaulding-Drum development.

Delegates making the trip through the Pacific Northwest will be taken over the Long Lake development of the Washington Water Power Company at Spokane and over some of the Puget Sound Power & Light Company's more recent projects near Seattle. Arriving in Portland, they will be the guests of the Portland Electric Power Company on a trip up the Columbia River Highway or an alternate trip to the Oak Grove plant of that company on the Clackamas River. This station contains the highest-head reaction turbine in the world, operating under 860 ft.

Owen D. Young on Rural Electrification

Chairman of General Electric Board Dwells Upon the Respective Parts that the Farmer, the Central-Station Company, the Manufacturer and the State Must Play

SPEAKING as a practical farmer who had experienced all the drudgery of old-fashioned rural life and as a lawyer and an executive who for fifteen years had studied the problems of electric light and power supply and for twelve additional years the problems of the electrical manufacturer, Owen D. Young, chairman of the board of the General Electric Company, discussed "Farm Electrification in New York State" at Albany last Monday, April 6, under the auspices of the Empire State Gas and Electric Association and before representatives of farm, university and electric public utility organizations. The problem of rural electrification, Mr. Young said, can be solved only by answering four other questions: (1) What can the farmer do? (2) What can the power company do? (3) What can the manufacturer do? (4) What can the state do? In part Mr. Young said:

"The one point which I want to make to the farmer is that the manufacturing companies may produce devices, the electric power companies may bring electricity to his door, but the question remains with the farmer whether he will put it to work. It is he, in the last analysis, who must say whether or not electricity is to be used in agriculture.

THE POWER COMPANY'S PLACE

"What can the power company do? First of all, it can show the same interest in the study of the needs of the farmer as a potential customer that it has heretofore done so effectively with reference to industrial and commercial customers. The companies should create agricultural departments with men in charge who not only know the electrical business but who know the farming business. These men should be in close touch with the agricultural schools and colleges. They should work through co-operative committees.

"Twenty-five years ago the light and power companies did a local business in each municipality. Today a change has occurred in that business. It has been found that it is in the interest of the industry as well as of the community to have great central power stations, favorably located, supplying a large territorial district composed of many communities, in place of the small individual plants for each community. The cost of power supply is reduced through these larger and more economical generating units. It has been found of advantage to the power companies to diversify the load by the different uses to which power is put in different communities at different times of the day. When, however, great districts are served by a single power company, when great power transmission lines are run through rural communities in order to connect one city with another, when the farms and small villages find they cannot tap for service these lines which run directly by their door, they begin to ask, and in my judgment properly ask, why if they are a part of this great integrated power district, they should not have their service too.

"The fundamental limitation under which the power company can supply these services to the whole community is that the rates should be such that the earnings from the community as a whole will yield a fair return on the investment of the power company as a whole. Therefore, in my judgment, rates should be studied from this point of view. The public service commissions should co-operate and even insist upon their establishment.

"The manufacturer, too, is subject to the indictment of want of interest. He has sought to apply electricity to everything in the world except the farm. He has spent enormous sums on research and engineering. He has not yet met by sufficient expenditure of energy or money the problem of the farmer. Without electrical machinery adapted to farm use, the farmer cannot extend the use of electricity to his profit. Unless he can extend it to his profit, he will not use it, and unless he becomes a substantial consumer of power, it will be economically impossible for the power companies to supply the service. Therefore, the manufacturing companies must endeavor to develop these agricultural applications. So far as I am able to speak for the great concern with which I am proud to be connected, I pledge you now its co-operation and its effort in trying to answer the question before us.

FIELD OF THE STATE

"And now as to the state. What can it do? This is one field in which I have not had experience. Let me be very specific now and address myself to the State of New York. Nowhere else in the world are there such resources of water power contiguous to so great a market. The God-given storage of the great lakes and the drainage area of half a continent is collecting water and equalizing its flow over the falls of Niagara and down the rapids of the St. Lawrence, all for the economic benefit of the State of New York. In addition to the great powers on the boundary streams, which are capable of carrying the base-load operations of the state, we have smaller powers in the Adirondacks, on the Genesee and on the Delaware which, with adequate storage, could be developed to carry the peak loads that occur at different hours during the day. These powers can be laid down on great busbars throughout the state and made available everywhere within the state. What would it mean to the Mohawk Valley if a million horsepower were to be laid down along its six tracks of railroad and the Barge Canal? Industries which have been seeking the cheap coal of Pennsylvania and the waterway of the lower Delaware would find their way into the district in which I now stand. The increasing population of that district would enlarge the market for all the farms in this state. They would become more valuable instead of becoming less valuable. Our industries would be largely increased instead of standing more or less stationary. Still, the power which is necessary to do this job runs to waste. And why? It is because the people of the State of New York have permitted this great economic question to become a political football.

"What are the slogans which mislead us? One is that the grasping power company is trying to destroy the scenic beauty of Niagara Falls, and yet I think I am right in saying the latest studies show that, in view of the corrosion, scientific handling of the Falls must be had in order to preserve their beauty, and that it may be had consistent with great additional power development there. Next time the slogan is the destruction of the Adirondack forest —the playground for the people. Are we so incompetent in this state that we cannot develop plans to conserve and use the waters of that great watershed for the benefit of all the people of the state without destroying or impairing in the least the beauty and the development of that great forest?

"Finally there comes the most effective slogan of all—the power trust is trying to steal these natural resources for its own benefit and take them away from the people. If there be a power trust, which I deny, most people would admit that I am competent to speak about it. It is evident that nobody can make a dollar out of these falling waters except by harnessing them for the service of the community. No capitalization of the developing company can be had and no rates can be charged except such as are approved by the Public Service Commission of the state. What is there to this charge of stealing the water powers if they can only be developed under state control, and if they can only make their money by rates approved by the state, and if their income can arise only from putting the power which is now going to waste to the service of the people? I propose that the people of the state demand now that this economic proposition be dealt with on an economic and sensible basis, that the powers be made available and that we substitute economic progress for political horseplay."

COMMITTEE REAPPOINTED

Other addresses were made by Prof. H. W. Riley of the State College of Agriculture and C. R. Vanneman, chief engineer of the Public Service Commission. M. S. Sloan, president of the Empire State Gas and Electric Association and of the Brooklyn Edison Company, who presided, reappointed a committee named some time ago to continue study and investigation of farm possibilities. Its members are George T. Bishop, chairman of the board of the Niagara, Lockport & Ontario Power Company; J. N. Carlisle, president of the Northern New York Utilities, Inc.; James C. De Long, president of the Syracuse Lighting Company; Henry O. Palmer, vice-president of the Empire Gas & Electric Company, Geneva, and Charles S. Ruffner, vice-president of the Adirondack Power & Light Corporation.

Fitkin May Buy Municipal Service Company

Properties of the Municipal Service Company of Philadelphia, whose operations have been supervised by Day & Zimmermann, are, it is reported, to be taken over by A. E. Fitkin & Company, New York, about June 1. The Municipal Service Company was incorporated in Maine as a holding company. It has an authorized capital of 100,000 shares of common stock with no par value and $5,000,000 of a 6 per cent preferred stock. It owns substantially all of the preferred and common stock of the Chester Valley Electric Company of Coatesville, the Titusville Light & Power Company, the Citizens' Traction Company of Oil City and Franklin and the York Railways Company, all of Pennsylvania; the Alexandria Light & Power Company of Virginia, the Valdosta Lighting Company and the Ware County Light & Power Company of Georgia and the Youngstown & Suburban Railway Company of Ohio.

The Citizens' Traction Company of Oil City owns and operates the Citizens' Light & Power Company of that place. Similarly the York Railways Company owns virtually all the stock of the Edison Light & Power Company of that city. From York the statement is made by J. E. Wayne, vice-president and manager of the Edison company, that while negotiations are under way, nothing definite has as yet been done and that no date has been set for the sale. Should the deal be consummated, he added, it would not mean any change in the local management or operation of the Edison company.

Another recent acquisition by A. E. Fitkin & Company is a group of companies, mainly in Pennsylvania, hitherto owned by the American Electric Power Company. Most of these are electric railway, bus or gas utilities, but included in the lot are the Home Electric Light & Steam Heating Company of Tyrone and the Logan Light & Power Company, as well as the Monmouth Lighting Company of Keyport, N. J., and the right to purchase the common stock of the Shore Lighting Company, serving New Jersey resorts. The acquisition of these two New Jersey companies by the Fitkin interests has been previously reported in the ELECTRICAL WORLD.

More Applications for Federal Water-Power Permits

The Federal Power Commission has received an application from J. W. Preston for a preliminary permit covering a project on the Middle and South Fork of the Mokelumne River and the North Fork of Calaveras River in Calaveras County, California. The plan is to construct a diversion dam in the South Fork of the Mokelumne 2 miles above the mouth with a conduit to a power house on the main river 3 miles below the mouth of the North Fork. The power is intended for public utility use. Irrigation also is contemplated.

An application for a preliminary permit has been filed with the commission by H. W. Coe covering the proposed project already noted on Toutle River and Spirit Lake in Cowlitz and Skamania Counties in Washington. The waters of Spirit Lake would be raised by a dam so as to create 16,000 acre-feet of storage. A diversion dam also is planned on Toutle River below the mouth of Cold Water Creek. A 10-mile flume would convey the water to a power house on the river, where 13,000 hp. would be installed. The power is intended for public utility and mining purposes.

The Utah Light & Traction Company has applied to the commission for a license covering its Stairs plant on Big Cottonwood Creek. This is a constructed plant. The Utah Power & Light Company has applied for a license covering various improvements in connection with its constructed Olmsted plant.

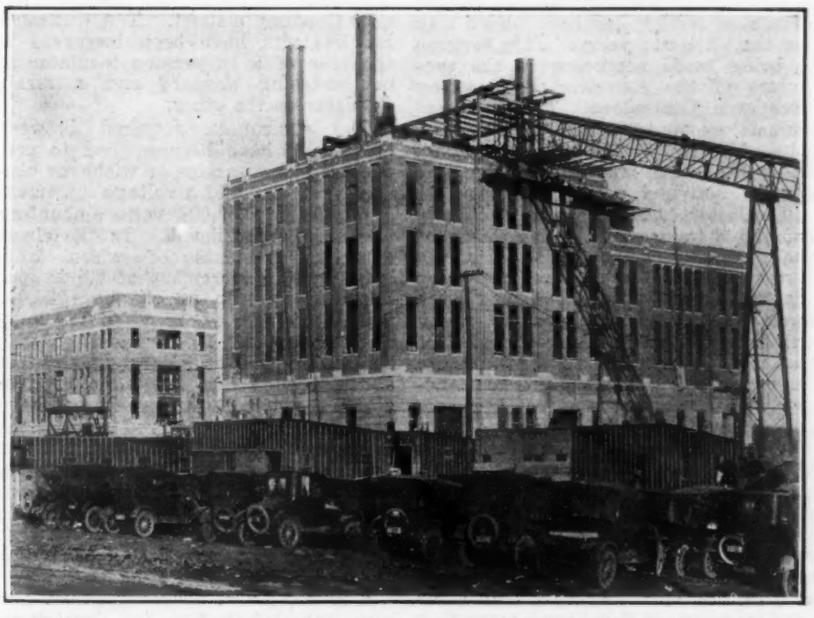
The Southern Sierras Power Company has applied for a license covering four storage reservoirs to provide additional irrigation waters and to be used for the development of power through existing hydro-electric plants on Bishop's Creek. The reservoirs are to be on the North and Middle Forks of Bishop's Creek, near Inyo, Cal.

A new application for license has been submitted to the commission by the Hydraulic Race Company, which desires to operate in the Niagara Peninsula of New York State. The application points out that the various mills which are to use the water successively are now in agreement and that it will be possible to develop full head by spilling the water at Lockport from the Erie Canal and running it through Eighteen-Mile Creek.

Hudson River Regulation and Hydro-Electric Power

The nine-million-dollar Sacandaga Reservoir development in New York State, under the supervision of the Hudson River Regulating District, has now reached a point where if, after final hearing on April 17, no objection is had to the estimate of total cost and apportionment of cost, the actual work of the development may be expected to commence. Indirectly the development constitutes a connecting link with the "deeper Hudson" movement sanctioned by Congress because its operations will affect the mean flow of the Hudson River. The development fits into the power situation because the impounding of this vast amount of

Davenport's New Plant Will Be Ready in June



BUILT on a 92-acre tract a few miles east of Davenport, Iowa, on the north bank of the Mississippi River, and representing an investment of $2,500,000, the new generating station of the Riverside Power Manufacturing Company, subsidiary of the United Light & Power Company, will be completed and tied in with the distribution system of the latter company on June 1, officials of the corporation predict. Construction was commenced January 1, 1924. This plant, when tied in with the United Light circuit, will increase the output of electrical energy locally by 50 per cent. It is constructed on the unit system with future expansion to an eventual twelve-million-dollar development in mind. Foundations of the plant were laid in the solid rock.

A 25,000 kw., three-phase, 60-cycle, 13,200-volt Westinghouse turbine, operating at a steam pressure of 400 lb. and a total temperature of 700 deg., is to be the initial generating unit. Coal, which can be received over the switch tracks of two railroads, will be dumped into a receiving hopper outside the plant, run through a breaker and carried on an inclined belt to the bunkers in the roof of the boiler house. There is ample storage room for fuel. Switching will be done by an electric locomotive. Design and construction of this new plant is in charge of the engineering and construction division of the United Light & Power Company. It is planned to carry the load of the Tri-Cities and surrounding towns for many years to come.

water, embracing miles of territory in its area, will create by its natural and regulated flow downward toward the Hudson River increased horsepower which it will be possible for public utility corporations and municipalities to harness and convert into electrical energy.

The largest contributor in the apportionment of costs will be the Adirondack Power & Light Corporation, which will be called upon to pay three contributions amounting to more than $2,500,000, while the International Paper Company will pay more than $1,000,000. If the final determination be in favor of the project as it has been submitted, bonds will be issued as needed to carry out the work and assessments to meet them will be levied as the interest becomes due or the bonds mature.

Electrical Safety Code

Revisions for Rules for Line Construction and Operation Completed —Main Changes Explained

THE last edition of the National Electrical Safety Code was completed in 1920 and issued in 1921. In the following year it was approved by the American Engineering Standards Committee as an American standard. A revision preparatory to the issuing of a new edition has been under way for the past two years. This revision is being made according to the procedure of the American Engineering Standards Committee. Two sectional committees were formed, one to deal with interior work and grounding, while the other was to consider line construction and operating rules.

The latter committee has practically completed its work. At a meeting of the sectional committee held at the Bureau of Standards, Washington, on March 5 and 6, final decisions were made as to the requirements which will be contained in Parts 2 and 4 of the next edition. Among the more important changes in the line construction rules which were agreed upon are the following:

The loading specification upon which the strength requirements of poles, towers and conductors are based was changed. In medium loading territory the loading specification is based upon the assumption of conductors covered with ice to a radial thickness of ½ in. and experiencing a transverse wind pressure of 8 lb. per square foot of projected area of cylindrical surfaces. For light loading no ice is assumed upon the conductors, but a transverse wind is assumed which will give a pressure of 12 lb. per square foot. As a longitudinal loading requirement at crossing supports and sections of higher grade in a line which is elsewhere of a lower grade of construction, all wires are assumed broken, but in spans of less than 500 ft. a limit of 50,000 lb. is set to the load which must be resisted. In lines of uniform construction only one-third of the conductors are assumed to be broken.

The map which defines the three loading districts has been modified so that all of Montana and the larger part of Wyoming are thrown into the medium loading district. Minor changes are made in the Southwest and along the Atlantic Coast.

A table of working stresses for steel used in supporting structures has been established. The values for Grades A and B are but slightly different from the old values, but for Grade C the working stresses have been reduced.

In the case of wooden poles, the factor of safety has been increased from 3 to 4 for isolated crossings where untreated poles are used. For treated poles in conflicts and joint use, the factor of safety has been reduced to 2½, 1⅔ and 1, for Grades A, B and C.

The following items have been changed to agree with the specifications of the American Railway Association: The factor of safety for guys used to obtain transverse strength has been reduced from 3 to 2 for Grade A construction. For signal line crossings over tracks the A.R.A. tables for head guys and for the sags of conductors have been substituted for the former code requirements. In defining clearances, a 45-deg. swing of suspension insulators is assumed. For the clearance of wires above ground or tracks the increment to be added in the case of long spans has been increased to 0.1 ft. for each 10 ft. of the excess over 150 ft., but a fixed limiting value for this increment has been set for each loading district. The clearance requirements have been increased in the case of a suspension insulator at one crossing support and a strain insulator at the other.

The clearances required between cross-arms have been applied to conductors in bow-arrow or wishbone construction, etc., and a voltage increment applied above 50,000 volts amounting to 0.4 in. per kilovolt. In the clearance requirements of wires from buildings, an increment of 0.5 in. per kilovolt has been added above 50,000 volts to the 10 ft. required for voltages between 15,000 and 50,000. Reductions in the clearance required above ground for low-voltage wires along roads and over walkways have been made. The required separations between conductors were increased for the higher voltages and longer spans.

More liberal provisions have been made for the use of buckarms. A distinction has been made between conflicts of pole lines and conductor conflicts.

A new table of flashover values has been established for line insulators. Requirements are made only for flashover values when dry, and no values are specified for the wet condition. The values are somewhat higher than formerly for the disk type of insulator. A 25 per cent increase in the required flashover value is made for insulators used with grounded arms at railroad crossings if the line elsewhere is of wooden construction.

Supply circuits are forbidden to use the ground as a return in normal operation in urban districts. There is also a recommendation against such practice in rural districts.

The rule stating when the joint use of poles by supply and signal circuits is desirable has been reworded in a form which is satisfactory to both the power and telephone companies.

Briefer News

Peoria-Springfield Line Goes Into Service. — The 78-mile, 132,000-volt transmission line between Springfield and Peoria, Ill., to supply the Illinois capital with power from the new station of the Illinois Electric Power Company at Peoria, went into commission last week. Energy is received in Springfield at the recently finished Bergen Park station and stepped down for city distribution.

Second Unit of Pineville (Ky.) Plant Starts.—In late March the Kentucky Utilities Company, Louisville, completed and started operation of the second 15,000-kw. unit of its generating plant at Pineville, which will furnish energy throughout eastern Kentucky and as far as Louisville, when operated in conjunction with the Dix River hydro plant. The Pineville plant has been operating one unit since last year.

Connecticut Light & Power Aims for an Ultimate Rating of 200,000 Kw.— The Connecticut Light & Power Company is reviewing plans for an addition to its plant at Devon, Conn. The plant's present capacity is 67,500 kw. and plans contemplate an ultimate capacity of more than 200,000 kw. The first step will be the addition of a unit increasing the capacity nearly 50 per cent.

"Electrical World" Editor to Broadcast from Boston.—A brief story of electrical progress will be broadcast from the Boston Edison company's radio transmitting station (WEEI) next Friday at 6.20 p.m. by Robert M. Davis, statistical editor of the ELECTRICAL WORLD, who is supplementing a recent tour of the West and South in the interest of the industry by a visit to New England.

Georgia Railway & Power's Marietta-Lindale Line.—The Georgia Railway & Power Company is making steady progress on its 38,000-volt, 45-mile high-tension line from Marietta to Lindale, Ga. The line has now reached Taylorsville, about two-thirds of the distance, where it supplements a 110,000-volt line built four years ago and will give ample additional power for the industries of the section. Single posts are being used to carry the 38,000-volt line and are reported to be just as effective for the work as larger steel towers.

Indiana Stone Companies Charge Discrimination.—An investigation of alleged discriminatory charges for electric power rates by the Interstate Public Service Company is asked in a petition just filed with the Indiana Public Service Commission by ten stone companies operating in the Bedford district. According to the petition the firms used and paid for 4,379,590 kw.-hr. during 1924 and paid to the Interstate company $147,137, of which amount $28,847 was for demand or investment charges.

Muscatine (Iowa) Municipal Plant Reports Success.—The municipal electric plant of Muscatine, Iowa, which

was erected at a cost of $375,000 and placed in operation last June, is now, according to the officials in charge, serving 2,370 customers besides the city's public needs and shows a revenue in excess of cost of operation of nearly $3,000 for the time it has been in service. The street lighting is admitted to be inadequate, but will be extended.

Sale of Okemah Municipal Plant to Oklahoma Power Company.—The Oklahoma State Legislature, which recently adjourned, ratified the sale of the Okemah municipal generating plant and distribution system to the Oklahoma Power Company, according to the agreement reached last year and carried by a four-to-one vote at the polls.

Proposed Legislation Affecting Ontario Hydro Commission.—Strong representations which have been made by retailers to the Ontario government culminated on April 2 in the introduction in the Legislature of a bill placing the retail stores of the Ontario Hydro-Electric Power Commission in the same category as other retail stores as regards liability to taxation. Two other provisions in the bill are one that power liens shall not rank before mortgages and one making provision for the payment to the province of $620,000 of deferred interest on the Nipigon development.

Additional Power Facilities Considered by British Columbia Company.—An extensive survey and investigation of the power site and permits of the Bridge River Power Company on Bridge River in British Columbia is being made by the British Columbia Railway Company, with a view to the possible purchasing of such property and rights for future hydro-electric power development. The plans of the Bridge River Power Company called for an initial development of 62,400 kva., under a head of 1,140 ft., out of a potential development of 335,000 kw. It is understood that the British Columbia Electric Railway will decide during the present year whether to purchase the Bridge River site or make another power development on Stave River.

E. H. Rollins & Son Buy Natural-Steam Plant.—The Geysers Development Company, which is constructing a 2,500-kw. natural-steam power plant at The Geysers, 30 miles northwest of Santa Rosa, Cal., has been sold to E. H. Rollins & Sons of San Francisco, who exercised an option held by them after a favorable report had been received from John D. Galloway, consulting engineer. It is said that other financial interests had been trying to buy the company. The Rollins firm will put $1,500,000 into the new company and will be the largest stockholder. John D. Grant, who was president and general manager of the Geysers Development Company, will be the second largest stockholder. Work on the power plant will, it is said, be speeded up.

Fort Wayne to Have Residential Lighting Rate of 5 Cents.—Residential consumers of light and power at Fort Wayne, Ind., will enjoy one of the lowest rates in the whole country if the schedule filed by the Indiana Service Corporation meets with the approval of the Indiana Public Service Commission. The revised schedule provides for a reduction of one cent under the present rate and is as follows: For the first 60 kw.-hr., 5 cents per kilowatt-hour; next 140 kw.-hr., 4 cents; all over 200 kw.-hr., 3 cents; minimum monthly charge, 75 cents. Robert N. Fuestel president of the Indiana Service Corporation, which was recently taken over by the Insull interests, in announcing the new rates, said that only Cleveland among the large cities of the United States had a rate as low.

Coming Meetings of Electrical and Allied Societies

[A complete directory of electrical associations, with their secretaries, is published in the first issue of each volume. For latest list see ELECTRICAL WORLD, January 3, page 76.]

American Institute of Electrical Engineers—St. Louis, April 13-17; Swampscott, Mass. (regional), May 7-9; Saratoga, N. Y., June 23-27. F. L. Hutchinson, 33 West 39th St., New York.

Wisconsin Utilities Association—Hotel Pfister, Milwaukee, April 16. J. N. Cadby, 445 Washington Bldg., Madison.

New Mexico Electrical Association—Albuquerque, April 20-22. B. L. Wiles, Albuquerque, N. M.

Southwestern Division, N. E. L. A.—Eastman Hotel, Hot Springs, Ark., April 21-24. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Arkansas Utilities Association—Hot Springs, Ark., April 21-24. R. I. Brown, Arkansas Central Power Co., Hot Springs, Ark.

American Welding Society—New York, April 21-26. Miss M. M. Kelly, 29 West 39th St., New York.

American Electrochemical Society—Niagara Falls, N. Y., April 23-25. C. G. Fink, Columbia University, New York.

Southwestern Public Service Association—Rice Hotel, Houston, Tex., May 5-8. E. N. Willis, 403 Slaughter Bldg., Dallas.

Missouri Association of Public Utilities—Joplin, Mo., May 7-9. F. D. Beardslee, 315 North 12th St., St. Louis.

American Society of Mechanical Engineers—Milwaukee, May 18-21. C. E. Davies, 29 West 39th St., New York.

Southeastern Water and Light Association—Hotel Patten, Chattanooga, Tenn., May 19-21. W. F. Steiglitz, Columbia, S. C.

Electrical Manufacturers' Club—Hot Springs, Va., May 19-22. S. B. Belden, Jeffrey Manufacturing Co., Columbus, Ohio.

Middle West Division, N. E. L. A.—Hotel Fontenelle, Omaha, Neb., May 20-22. (Conjointly with Nebraska Section.) H. M. Davis, Fraternity Building, Lincoln, Neb.

Georgia Electrical Association—Atlanta, May 21-22. W. W. Barr, Georgia Railway & Power Co., Atlanta.

Electric Power Club—Hot Springs, Va., May 25-28. S. N. Clarkson, B. F. Keith Bldg., Cleveland, Ohio.

Electrical Supply Jobbers' Association—Hot Springs, Va., June 2-5. Franklin Overbagh, 411 S. Clinton St., Chicago.

American Association of Engineers—Orlando, Fla., June 2-5. C. E. Drayer, 63 East Adams Street, Chicago.

Iowa Section, N. E. L. A.—Waterloo, Iowa, June 3-4. H. E. Weeks, 623 Union-Davenport Bldg., Davenport.

National Electrical Credit Association—Atlantic City, June 6-7; Philadelphia, June 8-9. F. P. Vose, Marquette Bldg., Chicago, Ill.

Associated Manufacturers of Electrical Supplies — The Homestead, Hot Springs, Va., June 8-12. F. Nicholas, 30 East 42d St., New York.

Northwest Electric Light and Power Association (Geographic Division N. E. L. A.)—Gasco Bldg., Portland, Ore., June 12. W. A. White, Puget Sound Power & Light Co., Portland.

Pacific Coast Electrical Association (Geographic Division N. E. L. A.)—San Francisco, June 15. S. H. Taylor, 529 Rialto Bldg., San Francisco.

National Electric Light Association—San Francisco, June 15-19. M. H. Aylesworth, 29 West 39th St., New York.

Society for the Promotion of Engineering Education — Union College, Schenectady, N. Y., June 17-20. F. L. Bishop, University of Pittsburgh, Pittsburgh.

Otter Tail Company Buys Another North Dakota Property. — The Otter Tail Power Company of Fergus Falls, Minn., whose North Dakota acquisitions were recently noted in these columns, has now bought the Sheyenne Valley Light & Power Company of Valley City, N. D. The Sheyenne company has been purchasing energy from the municipal plant and transmitting it to eight small communities.

Arkansas Owes Its First Big Textile Mill to Electricity.—A celebration of the opening of the first large textile mill to be built in Arkansas took place last week at Pine Bluff, the site of the new industry, which has ten thousand spindles. The mill follows the completion last fall of the Arkansas Light & Power Company's 24,000-hp. hydro-electric plant at Remmel Dam, without which it could not have been built.

Pike's Peak Railroad May Be Electrified. — The famous cog railroad up Pike's Peak, in the Colorado Springs region, now operated by steam, may soon become electrified if Harrison J. Holt, president of the road, and A. M. Wilson, City Manager of Colorado Springs, can agree on rates for power from the new municipal generating plant in that city. Preliminary plans for electrification have already been investigated by Wood & Weber, consulting engineers in Denver, the firm which has charge of the Colorado Springs municipal light and power project. If the road is electrified, it is planned to supplant the present bulky cars by cars of lighter steel construction with glass tops and sides. Final decision rests in the hands of the directors of the railroad.

Blue River, Col., Has 45,000 Hp. Still Undeveloped.—Engineers of the Interior Department have recently mapped Blue River, on the western slope of the Continental Divide, about 70 miles west of Denver, and have found six power sites between Breckenridge and the mouth of the river which have a capacity, with the existing flow, of 22,000 hp. for 50 per cent of the time and 12,000 hp. for 90 per cent of the time. The power available can be increased nearly four times by constructing a reservoir having a capacity of 230,000 acre-feet, and a site for a dam that would create such a reservoir was discovered and mapped in Green Mountain Canyon. With this reservoir in operation the capacity of the six sites would be 45,000 hp. for 50 per cent of the time and 42,500 hp. for 90 per cent of the time.

Wisconsin Utilities Association to Meet Next Week.—Assembling at the Hotel Pfister, Milwaukee, on Thursday, April 16, the Wisconsin Utilities Association, of which Grover C. Neff is president, will listen to an address by Lewis E. Gettle, chairman of the Wisconsin Railroad Commission, on "Re-

cent Wisconsin Court Decisions Affecting the Regulation of Wisconsin Utilities." Other addresses will be given by T. D. Crocker, Northern States Power Company; Marshall E. Sampsell, Wisconsin Power & Light Company, and George E. Frazer of Chicago, the last named discussing recent developments in public utility financing. Group luncheons will take place, and the banquet in the evening will be made an opportunity for musical entertainment with an address on "Our Federal Constitution" by Harry F. Atwood of Chicago.

Cleveland Electric Illuminating Company Builds New Automatic City Substation. — The Cleveland Electric Illuminating Company is building a substation on Bolivar Road near East Ninth Street, within two blocks of the city's busiest street intersection. It is to have an ultimate capacity of 24,000 kva. and will be connected with the Lake Shore generating station by means of 11,500-volt underground cables divided equally between alternating-current transmission for industrial consumers and street-railway substations and direct-current feeders for the buildings in the business district, which are rapidly increasing in number. Five rotary converters of 3,250 kw. each will be employed. The substation will be automatically operated.

Blanchard Rapids Plant of Minnesota Power & Light Starts Up.—The largest water-power plant on the Mississippi River north of Minneapolis, the one at Blanchard Rapids, 2 miles south of Royalton, has just started operation, sending northward to the Cuyuana and Mesaba Iron Ranges 110,000 kw.-hr. of electricity each day. The plant, which contains two 9,000-hp. turbo-generators, is owned by the Minnesota Power & Light Company. Work on the plant, which cost more than $3,000,000, was started more than a year ago. It is the first of a series of power projects to be built on the Mississippi between Brainerd and Minneapolis. A high-tension line running 137 miles to Nashwauk carries the power from the dam to the Mesaba Iron Range. At Riverton the line is tapped to supply the Cuyuana Iron Range and points north. A second dam is being planned at Rice, 8 miles below the Blanchard Rapids site; a third is planned for Clearwater, 14 miles south of St. Cloud, and a fourth at an undetermined site between Clearwater and Elk River.

New Mexico Legislature Asked to Prevent Destructive Competition by Utility Companies.—A bill has been introduced in the New Mexico Legislature to amend the state law so as to require a competing company to go into court to prove public necessity as a prerequisite to obtaining a franchise. The bill attracted public interest in Albuquerque because of the endeavor of the Hagan Power & Electric Company to enter the light and power field there, and the Senate committee hearing was largely attended. Arthur Prager, manager of the Albuquerque Gas & Electric Company, which has a twenty-five-year franchise, made the points that a duplication of service does not mean reduced rates, that an investment of any individual or corporation in public service work should be protected by the people the company serves so long as that company is fair and just in its operations, and that encouragement should not be given to the establishment of plants manufacturing heat, light and power for the purpose of burdening an existing corporation with the necessity to purchase their output under threat of competition. The committee adjourned without taking action.

Pacific Gas & Electric Now Occupies New Building

OFFICERS and employees of the Pacific Gas & Electric Company are now settled in their new home at Beale and Market Streets, San Francisco. All executive and general offices are contained in this seventeen-story building, which occupies a ground space of 153 ft. x 153 ft. and has a floor area of 184,000 sq.ft., with room for an expansion of 47,000 sq.ft. through completion of what is now a four-story wing. The building and site represent an investment of $2,500,000. The front of the building is ornamented with California mountain sheep and bear heads, and over the main entrance two allegorical figures typify the light and power industry.

NEW HOME OF SAN FRANCISCO COMPANY

An automatic telephone system has been installed throughout for intercommunication between the offices in the building and those of the district and operating departments elsewhere in the city. In addition a dictograph system has been installed for use by the executives. Six Spencer-Westinghouse elevators have been provided. Special studies were made of illumination. An average intensity of 10 foot-candles has been provided for offices and a minimum of 25 foot-candles for drafting areas. Indirect-type units are used. The building will be floodlighted from across the street, from the fourth to the fourteenth floor, by sixty 1,000-watt projectors, and 500-watt projectors will be placed at the base of the columns on the fourteenth floor for lighting the upper portion. The sixteenth floor has been set aside for employees' lunch and rest rooms, and an auditorium, which will seat five hundred people, has been provided on the first floor.

Northwestern Electric Company Moves Into Larger Quarters.—Because of the crowded condition of the offices of the Northwestern Electric Company, Portland, brought about by the growth of the company, new general offices on the second floor of the Pittock Block were occupied recently. The new offices utilize 9,000 square feet of area in the southwest corner of the building and front 120 feet on Washington Street. The appliance store and pay station on the ground floor of the building on the corner of Tenth and Washington Streets will be continued in that location.

Texas Power & Light Buys Lockhart (Tex.) Plant.—An early extension of the electric power transmission system of the Texas Power & Light Company from its present southern terminus at Taylor south to Lockhart, 65 miles, and thence to a number of towns in the territory to the east and north of San Antonio, is planned. As a step toward the fulfillment of this expansion program the company has just purchased the electric light and power plant of the Citizens' Water & Light Company at Lockhart for a consideration of $350,000. Negotiations are pending for the purchase of plants in other towns in the territory that is to be invaded by the power transmission system, it is stated. In connection with the construction of these power lines into the more southern part of the state an additional power station to meet the demands of the enlarged service will be built by the company either at Austin or Bastrop.

Dothan, Ala., Not Successful in Its Plans for Municipal Plant.—Dothan, Ala., a city of 10,000 people, obtained a license from the Federal Power Commission in August, 1922, to build a dam in the Choctawhatchee River and floated bonds to the amount of $750,000 to erect a 6,000-hp. plant. Dissatisfied taxpayers obtained a court injunction against the plant, which was never completed. Floods washed away what had been built. Now a local reporter writes in a local paper: "The writer went yesterday to Chalker's Bluff, where Dothan's hydro-electric plant used to be under construction. He wanted to view what was left after the recent floods. Mostly what is left are the workmen's houses on the bluff. The city's hydro-electric project presents the dejected appearance of a mining camp abandoned in 1904. Here and there are abandoned huts and other sickly testimony of the $750,000, such as parts of the dirt dam across the river. The rest of the dam went with the flood. The writer's untrained eye miserably failed to see where the three-quarters of a million dollars has gone, even if there had been no flood. He is also at a loss to estimate the amount of money to complete the project; certainly it would not be less than $1,500,000. It seems hopeless to attempt completion of the plant on the present site. If we are to have water power, we shall be compelled to move either up or down the creek."

Men of the Industry

Donald MacArthur has been elected a director of the American Light & Traction Company to succeed General James H. Wilson, deceased, and **Richard Schaddelee** of Grand Rapids, Mich., was elected to the board to succeed James McCarthy.

R. M. Obergfell, assistant electrical engineer of the Underwriters' Laboratories since 1914, has been appointed associate electrical engineer of the electrical department. A graduate of the Lewis Institute, Chicago, Mr. Obergfell was for three years connected with the operating department of the hydro-electric development of the Sanitary District of Chicago.

Charles F. Sise, vice-president and general manager of the Bell Telephone Company of Canada, has been elected president, succeeding L. B. McFarlane, who has become chairman of the board of directors. Both Mr. McFarlane and Mr. Sise are veteran members of the organization, the former's association with the company dating back to its inception in 1880 and the latter's to 1889.

Sir J. J. Thomson, eminent physicist, has been awarded the Faraday medal of the British Institution of Electrical Engineers. In making the presentation in London on March 19 Dr. W. H. Eccles said that Sir Joseph Thomson was following Clerk Maxwell, a worthy successor to Faraday. Sir Joseph's original papers had had a far-reaching effect on electrical thought. His outstanding achievements were his conception of electrical magnetic mass, which culminated in the work of Einstein, and the realization of the importance of the electron, leading up to the electronic theory of the atom.

H. F. Viot has been appointed general manager of the Southwestern lamp division of the National Lamp Works of the General Electric Company, effective April 1. Mr. Viot obtained his first experience with the Shelby Electric Company, Shelby, Ohio, which he joined in 1907. Two years later, after having covered the territory from Ohio to Colorado, he opened a branch office for the Shelby company in Omaha and in 1911 a similar office in Denver. From 1913 to 1917 he was again in Omaha, and since 1917 he has been in Chicago as manager of that district for the Shelby lamp division. Mr. Viot's new headquarters will be in Kansas City, Mo.

Harry B. Gilmore, for seventeen years manager of the distributing organization of the Western Electric Company at Boston, has been elected secretary of the company. He was transferred to the general offices at New York a few months ago as assistant secretary. Mr. Gilmore succeeds **George C. Pratt,** who will give his entire time to his growing duties as general attorney. Mr. Pratt has held the position of secretary since 1908 and he has been general attorney as well since 1919. He joined the Western Electric Company as corporation clerk in the secretary's office at Chicago in 1906. Mr. Gilmore began his service with the Western Electric Company in 1902 after his graduation from Dartmouth in the supply organization at New York. Subsequently he went to Chicago in the telephone sales department and from there directly to the managership of the Boston house. **D. S. Pratt** was elected an assistant secretary of the company.

C. E. Stephens New York Manager for Westinghouse Electric

Charles E. Stephens has been appointed manager of the New York office of the Westinghouse Electric & Manufacturing Company, taking the place of Arthur E. Allen, who has resigned in order to take a position with the Westinghouse Lamp Company. Mr.

C. E. STEPHENS

Stephens has been connected with the Westinghouse New York office since 1917, having been appointed manager of the supply department in that year and being later made manager of the central-station division.

He was born in Texas and attended the Ferris Institute at Ferris, Tex. He applied for a position with the Westinghouse company in 1900 and was placed in the company's shops at East Pittsburgh. Here he gained a great deal of practical experience in electrical matters and pursued a policy of working in as many different departments of the factory as possible, in order to widen his knowledge. He finally gained an appointment in the testing division, from which he passed into the engineering department. Next he was made manager of the arc-lighting section of the engineering department and was then promoted to become illuminating engineer of the general engineering department. Later he became manager of the illuminating section of the sales department, from which position he was transferred to New York.

Mr. Stephens has been active for many years in the American Institute of Electrical Engineers and was at one time vice-president of the Illuminating Engineering Society.

Samuel Insull, president of the Commonwealth Edison Company, Chicago, arrived in New York April 3 aboard the Cunard liner *Aquitania* after a short stay in Europe. While abroad Mr. Insull was the guest of honor at a dinner given March 24 at the British House of Commons by T. P. O'Connor. Among those present were the present Prime Minister of England, Stanley Baldwin, and several members of the British government. Mr. Insull in responding to the toast of the evening said that great changes had been wrought in America by the extension of electric power facilities. Vast areas in the South hitherto given over to agriculture were now the scene of industrial activity. There was scarcely a hamlet where electrical energy was not available at low prices. He had often wondered, notwithstanding the difference in the conditions between England and the United States, if the application of the same methods of mass production and distribution of electrical energy would not be one factor in reducing cost and helping British manufacturers to compete successfully with the markets of the world.

Dr. C. H. Sharp, technical director of the Electrical Testing Laboratories, New York; **Dr. C. O. Mailloux,** of New York; **C. E. Skinner,** assistant director of engineering of the Westinghouse Electric & Manufacturing Company, and **H. M. Hobart,** consulting engineer, sailed for Europe April 4 aboard the *Homeric* to attend the meetings of the International Electrotechnical Commission to be held at The Hague from April 16 to April 24.

Obituary

Lucian L. Nunn, pioneer developer of hydro-electric power in the West and a philanthropist noted for his educational work, died March 2 in Los Angeles after a long illness. Mr. Nunn was seventy-two years of age. He built one of the pioneer high-tension electric transmission lines developing a transmission system that carried 40,000 volts from his plant on the Provo River to the Mercur mining camp, and built the first plants at Niagara Falls for the Ontario Power Company, then among the biggest power plants in the world. In pioneering electrical development in Utah and Idaho Mr. Nunn put plants first on the Provo and Logan Rivers, later at Grace, Idaho. Other works that he inaugurated were plants at Malad, Idaho; on the Madison River in Montana and at Casper, Wyo. Originally trained for the legal profession at Harvard and in German universities, Mr. Nunn became interested in hydro-electric undertakings through his connection with mining operations at Telluride, Col., where he first began to work out high-voltage transmission. It is estimated that Mr. Nunn has given upward of $2,000,000 to educational work through the Telluride association and the Deep Springs organization. The Telluride association was formed in 1911 and now has an endowment from Mr. Nunn of more than $1,000,000. In Utah Mr. Nunn was president of the Telluride Power Company.

Commission Rulings

Whether Company's Stock Has or Has Not a Par Value Is Not a Factor in Fixing Rates.—In authorizing the Central Arizona Power & Light Company to issue 28,600 shares of common stock of no par value in exchange for 7,150 shares of common stock of par value of $100 a share and to sell an additional 11,400 shares of common stock of no par value, the Arizona Corporation Commission said that such changes in the financial structure could not affect the rates for service and therefore are not of importance to the patrons of the company, although it is essential to the successful operation of the utility that its financial structure be well balanced.

Ratio of Revenue to Investment Governs Necessity of Deposit.—The Missouri Public Service Commission has found that a rule of the St. Louis County Gas Company requiring a deposit from new consumers distant from the mains as a condition of extending service was unreasonable when the ratio of estimated revenue to estimated investment necessary for the extension was greater than the ratio of operating revenue to investment considering the property as a whole. The commission also pointed out that additional customers will later use the service, and the extension was ordered made without the exaction of a deposit.

Careless Operation of Municipal Plant Censured.—The Indiana Public Service Commission termed the sale of coal by the municipal electric plant of Greenfield to individuals on a partial-payment plan, with lack of good accounting, very bad practice. The commission also found that the municipal plant had been inefficiently operated both as to actual physical operation and the keeping of records and said that, since the plant was the property of the taxpayers, inefficient operation was a dereliction of duty on the part of the officials in charge. Since the gross income was more than a 20 per cent return on the book value of the property, rates were ordered reduced.

State Road Commission to Pass on Pole Locations. — The Maryland State Public Service Commission has announced a new plan for the construction of pole lines by utilities in the state. Hereafter electric light and power companies desiring to extend lines will be required to file a diagram of proposed extensions, which will go to the State Roads Commission for approval prior to the issuance of a permit by the commission.

Company Must Continue Promised Service When Revenues Are Not Less Than Expenses.—The Colorado Public Utilities Commission has ordered the Estes Park Water Company not to discontinue service long supplied to a customer who asserted that the company agreed to furnish him with water all the year, though the company maintained that the agreement was for the summer months only. Said the commission: "Where the revenues are equal to and exceed the operating expenses, the public utility must continue to render the service in question. There is no evidence showing that the respondent company is not making its operating expenses."

Analysis of the Components of a Rural Electric Service Charge. — In granting authority to the Northern States Power Company to revise its rural rates in the direction of uniformity and to avoid discrimination arising from extensions having been made under varying rules and agreements, the Wisconsin Railroad Commission said that a rural electric rate should be such as to stimulate the consumption of energy, that the respective costs per customer of operating and maintaining urban and rural distribution systems are not necessarily in proportion to the different lengths of conductor, and that a rural electric rate schedule containing a service charge and an energy charge is preferable to a stepped schedule or a schedule containing a minimum charge. Analyzing the service and energy components of a rural service charge, the commission said: "The service charge is based upon three elements of investment—(a) the company's general investment, (b) the company's special investment, (c) the customer's investment. The company's general investment consists of its investment in power plants and transmission equipment or the investments necessary to produce and deliver the energy to the distribution systems used to serve the customers. . . . The company's special investment covers the company's investment in equipment other than that included in power plants and transmission lines. It may include some investment in distribution lines, transformers, etc., used to serve the rural consumers, but ordinarily it will not include any investment beyond that in the customer's metering and service equipment. . . . The customer's investment includes the investment made by the consumer in the rural distribution system. It embraces the investment in lines, transformers, protective devices, etc." In further discussion, alluding to the necessity of designing a schedule that would guarantee the utility the excess charges on rural lines, which are for the most part independent of the consumption, while at the same time not discouraging an extensive use of electricity by rural customers, the commission observes: "If a step schedule only is used, it is obvious that the unit charge must be abnormal, which would discourage extensive use. Moreover, even with a very high unit charge in the first steps, it would be practically impossible to provide that the smaller user pay his just share of the charges that are independent of consumption unless this was accomplished through the application of a high minimum bill. . . . The service charge is much more flexible than a minimum charge. This charge makes due allowances for different sizes of installations and for variations in the investments of company and consumer."

Recent Court Decisions

Hysteria from Electric Shock May Set Up Permanent Partial Disability.—In an action brought by the Harrisburg Coal Mining Company against the Industrial Commission of Illinois, the Supreme Court of that state held that an employee might suffer permanent disability from hysteria brought on by electric shock and confirmed an award made by the commission on that ground. In this case the man injured caught hold of a 250-volt cable at a place where the insulation was worn and the current passed through his body for two or three minutes. To this fact he attributed a condition of nervousness and listlessness accompanied by headaches, intermittent pains and impairment of vision. Medical testimony was to the effect that while electric shock produces immediate and not remote effects, it may set up a condition of hystero-neurasthenia which can incapacitate a man for work. (146 N. E. 543.)*

Company's Rights to Water Maintained Despite Twenty-five Years of Non-Use.—Green vs. Gila Water Company was an action appealed to the Arizona Supreme Court, which upset the finding of the trial court granting damages to the plaintiff for the flooding of his land by a dam erected by the company on property below plaintiff's. The Supreme Court held that the record showed that the water company had at one time had the right to construct a dam at the point in question, where its predecessor in ownership had erected one. This original dam had been washed out in 1894, and owing to litigation over land title its restoration was not begun by the water company until twenty-five years later. This fact had been held in the lower court to invalidate the company's rights, but the Supreme Court held that the defendant, which had merely postponed the building of the dam until its title was secure, had not forfeited its vested interest. (232 Pac. 1016).

Condition of Cross-Arm Alleged to Be Cause of Accident Properly Submitted to Jury.—The verdict in a negligence case (Duncan vs. Derry Electric Company) hinged on whether the decayed condition of a cross-arm carrying service wires contributed to the sagging of these wires so that they came into contact with high-tension wires strung originally 2 ft. below them. Conflicting evidence on this point, the Supreme Court of New Hampshire held, raised a question for the jury, and an exception taken by defendant's counsel to the submission in evidence of pieces of wood taken from the cross-arm, on the ground that such evidence was remote and provocative of prejudice, raised a question of fact not reviewable where such items of evidence were not made part of the record. (127 At. 700.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Manufacturing and Markets

Build Export Sales Through Known Facts

Thorough Knowledge of Markets Essential to Best Results—Situation in Cuba Cited as Example—Sound Principles the Basis of Success

THE need for a very careful study of our export markets in preparation for their best development and the coming conflict in foreign trade was discussed recently at the Export Managers' Club, New York City. The following extracts are taken from papers read at a meeting held at the Hotel Pennsylvania, New York, on March 25:

By Lorin Emery

Assistant Manager Merchandising Department, International General Electric Company

Before effective selling effort can be made in our export markets certain basic data on these markets must be obtained and definite policies and practices adopted. The procedure in the development of any new business is well understood and is the same as would be applied to our domestic markets. The cardinal principles are: First, the worth-while markets must be determined; second, buying habits of these markets must be studied; third, channels of approach to these buyers must be selected, and, fourth, the strongest possible appeal to the buyer must be made.

The world's worth-while markets may be roughly determined by a study of commercial geography, supplemented and checked by government reports on imports and exports and the very valuable books written by travelers and residents abroad, as well as by our consuls, trade commissioners and commercial attachés. In fairness it should be added that the trade magazines published here and abroad can be, and are, of very great assistance in market studies of this kind. Other comparative data are useful, as, for instance, an index of the production or importation of building material, which is a guide to the manufacturer of electrical wiring and lighting equipment.

Buying habits also can be learned from government reports and books by trained observers, but are better studied in the field. Such habits can be gradually changed, but must be recognized and accepted. The bazaars of Bombay cling tenaciously to their inherited practices, while Latin-American importers and dealers are coming to specialize to a degree quite beyond our expectations of twenty years ago.

Channels of approach to buyers and channels for the movement of goods to the consumer are being offered by reputable houses in the importing centers of all countries sufficiently developed to be of interest to American producers. American concerns established in international trade and maintaining offices and agencies overseas also offer facilities to producers whose products may be confidently intrusted to them. The preparation of the selling appeal and getting it effectively presented to the ultimate user of the goods is the great and continuous problem of merchandising. After having determined the best markets, learned the buying habits of the public and the trade, selected the best channels for handling the goods, the machinery of distribution stands idle and unproductive, through failure to get to the ultimate consumers forceful and resultful sales appeals.

Buyer's Needs Must Be Studied

A manufacturer or producer who aims at dominance in an overseas market must find the means for presenting his goods to the consumer or buyer in a convincing manner and make him appreciate the benefits they will give him or the service they will perform. To do this intelligently and economically involves precise knowledge of the buyer's needs and his ability to buy.

The measure of the foreign market for consumer goods is far more difficult to get, and perhaps it may be interesting to point out the error of basing assumptions on our home market. In Australia and New Zealand household appliances are sold as labor-saving devices, in China the appeal is one of sanitation, and in Cuba it is the pride of possessing something not essential but representative of a higher plane of living. In the Argentine electric heaters are not sold as auxiliary or emergency devices for the bath or dressing rooms, but to be used as primary heating equipment during the relatively short colder season.

Cuba a Fertile Field

During 1924 Cuba produced, roughly, $250,000,000 worth, or about 4,000,000 tons, of cane sugar in 180 centrals or mills scattered throughout the island, representing about 30 per cent of the world's production of cane sugar and about 20 per cent of cane and beet sugar combined. A complete list of these mills, their location, operating companies, Cuban and principal offices, nationality of ownership, general managers and chief engineers, as well as their production, can be had for the expenditure of 30 cents for a Havana magazine printed in English. The financial and business center of this industry is Havana.

In 1893 one of the sugar mills was sufficiently progressive to install an Edison bipolar generator for electric lighting, yet from that time until 1910 sugar mills were generally considered as prospects for lighting equipment only and not prospects for power apparatus. During this period the sugar industry went through many vicissitudes, including Cuba's war for independence, and regained its strength about the time in 1911 when one of the larger centrals installed an electric power plant for motor-driven pumps, conveyors, etc. In both instances it should be noted that the initiative came from the mill and not from the manufacturers. The manufacturers contented themselves with supplying their standard equipment, allowing the mill operators to adapt them to the needs of sugar manufacture. These pioneers among the mill operators pointed the way to the electrical manufacturers. Then the manufacturers became interested and sent qualified men into Cuba for the purpose of studying the industry and becoming a factor in the development of sales propaganda and solicitation. It was found that the industry presented a ready-made field for their cultivation.

As an indication of the value of this market to electrical manufacturers it is interesting to note that in round figures the total electrical capacity installed in sugar mills in Cuba is something over 160,000 kw. in steam turbines alone. This generating capacity is greater than the present installed capacity of all other industries and public service corporations in the island.

Much Business Available

The estimated value of power equipment, including turbines, motors, and auxiliary devices, sold to sugar mills during the development of this campaign is in round figures $10,000,000, and it is estimated that without any allowance for expansion of the industry in the way of future planting the available business is in the neighborhood of $7,500,000. The upkeep and incandescent lamp requirements of the electrically operated sugar mills of Cuba are approximately $350,000 per year. It is probable that if the American electrical manufacturers had been more aggressive and had more promptly appreciated the value of this market, they would have had this business on their books some years earlier and would have enjoyed the replacement and supply business for a longer time.

It may be of interest to others than machinery manufacturers to note that these sugar mills are surrounded by a population employed on the plantation, and the number of employees is to a degree dependent upon the amount of sugar produced; therefore a survey of the market in any one of these plantations for any particular kind of goods may be used as a basis for determining the probable consumption of similar goods in other plantations in the same country. It is possible to check this total population against the reports of the number of individuals employed in the industry and from such a survey to obtain an index of the consumption of

goods as related to the total production of sugar in the republic.

The Cuban market presents every facility for the average American producer or manufacturer, provided his goods are salable. Many channels of distribution are available to him, but again he is confronted with the great problem of merchandising, which is sales solicitation. Goods are not sold when they are placed in the overseas warehouse. Probably the chief reason for the less satisfactory profit on sales in Cuba as compared with sales within the United States is our supersensitiveness to price competition when we are not thoroughly acquainted with its character. Experience shows that any company doing a substantial business of, say, $150,000 or more in Cuba can pay the expense of its own local representative by the additional profit it will obtain from a better understanding of the market.

By Julius Klein

Director of the United States Bureau of Foreign and Domestic Commerce

The gratifying increase in our export trade in 1924 over 1923, it having shown a gain of some $430,000,000 or more than 10 per cent, and the continued satisfactory gains in the opening months of 1925 have been offset to a certain extent by increasing doubts as to the dangers of competition from our European rivals in the leading overseas markets. There can be no question that the outstanding feature of the present international trade situation is this problem of the coming conflict among the great export nations. It is well at the outset to recognize frankly the intensity of this rivalry and the probable dangers which it involves to certain of our leading lines and trade positions. There has been so much misinformation circulated on the subject, bordering in some cases on near-panic and hysteria, inspired among us in a few outstanding instances by our competitors themselves, that it is high time for a calm, dispassionate view of the actual facts as to where we stand competitively.

There are two preliminary observations which might be borne in mind, possibly by way of consolation for those who are inclined to be panic-stricken. First of all, a casual summary of recent German and British trade papers and trade association reports reveals any number of indications of a precisely comparable fear on the part of our European rivals as to their prospects in the face of increasing American competitive effort. There is on every hand an evident searching for some plausible explanation of the persistence of American foreign trade success in spite of the six years in which Europe has had the opportunity to regain its overseas markets.

Second, it is well to remember that this is by no means the first instance of vigorous competition overseas. The period immediately before the war was marked by an equally intensive export effort, and the outstanding conclusion to be derived from that conflict, especially during the years 1910-13, is unmistakably encouraging to the American foreign-trade community. We were not only holding our own, but in such highly competitive areas as the A B C countries of South America we were rapidly overtaking our two rivals. If we examine the actual figures of the relative status of the three leading trade rivals in representative competitive markets, the situation is far from discouraging for our exporters.

Considering only the three most important South American countries, we note that in 1913 the United Kingdom easily led with a contribution of 29.7 per cent of their imports, Germany came second with 19.7 per cent, and the United States was third with 13.5 per cent, although gaining rapidly on each of the others. By 1923, however, the situation was entirely changed, the United States and the United Kingdom being virtually even with 24 per cent each, with perhaps a slight advantage in favor of the latter because of the heavy British interests in the Argentine. Germany had fallen far behind with about 13 per cent as her share. In other words, so far as the leading South American markets were concerned, the United States had nearly doubled her relative strength.

The issue between the American exporter and his rivals appears to be one strictly of whether quality or cut prices should prevail. As between the two there is to be no question as to the ultimate decision of the American merchant or manufacturer. A strict adherence to those high standards which have long given American wares their standing in oversea markets would seem to be the firmest, and in fact the only, foundation for a lasting edifice in our foreign trade. It is quite probable that this may mean a loss in certain lines and trade centers, but there is some comfort in noting that European price cutting seems to be decidedly on the wane for several strong reasons.

CREDIT EXTENSION IMPORTANT

Long-term credits have always a well recognized place in all business, whether export or domestic. The difficulty lies in their proper administration, and in this field it might be well to dispose of the absurd fiction that American firms are amateurs in the matter of proper credit extension. For nearly two decades all sober-minded and well-informed European exporters have admitted the superiority of long-time credit systems of such well-known American lines as agricultural implements, sewing machines, etc. If Germany proposes to resort to such dangerous short-cuts to temporary export inflation as excessive credits or prolonged price reduction, she will be building a house of cards which will collapse at the first flutter of international uncertainties.

The extraordinary risks attendant upon price gambling should be left to our competitors, and we should adhere to those sound principles which have always been the basis of successful merchandising at home and abroad—good quality, just terms, implicit compliance with commitments on delivery, and development of the best production technique. We must keep our heads and not be stampeded by any sudden or momentary shift in the trade currents or by the temporary advantages of our competitors.

Tail Should Not Wag Dog

Radio Sales by Big Supply Houses Should Not Distract Attention from Other Main Lines

THE phenomenal growth of radio sales by jobbers and the effect on sales of other departments suggests a condition that occurs from time to time in the electric supplies distribution field whenever one particular line of supplies and equipment becomes extremely popular. At such times there is a tendency for the entire sales organization to devote more interest and effort to the field that responds most quickly to cultivation, allowing other staple lines to suffer from inattention.

Radio sales of some jobbers have increased so rapidly that there has been a tendency on the part of the sales organization to consider the radio line worthy of the most attention. The tendency has been to transform some regular full-line jobbers into radio distributors. Such a condition is, of course, detrimental not only to the individual jobbers but to the industry as well. Many prominent jobbers have already segregated the radio equipment into a separate department with special salesmen assigned thereto and have thereby removed the temptation from the other regular salesmen to give too much attention to the line that has the greatest call at the time.

While no one will question the present importance of the radio line nor the future popularity and use of such lines of equipment, it cannot be said that specific equipment and methods of distribution have become standardized or staple enough to permit jobbers to plan their stocks and sales program very far in advance. For example, during the past two years there has been a constant decrease in the relative demand for parts and a corresponding increase in the demand for completed sets, while the demand for tubes has continued good throughout this period. It is difficult to say just what the immediate future holds in the way of relative demands for the important elements of radio equipment. It is therefore felt that the segregation of this department from the other standard lines removes any element of hazard that may exist and transfers it to a separate department where any risks can be safely handled.

All jobbers, large and small, would do well to recognize that their business has been built and their future prosperity will depend upon their service as a means of distributing staple lines of electrical supplies. The sober thoughts and plans of the jobber executive must not be deflected by popular demand for a particular line at any time. The jobber to be of most service must be constantly prepared to serve in the distributing channels for all legitimate lines of electrical merchandise, bearing in mind that particular lines that become extremely popular may more safely be handled by separate departments.

Business Conditions

SALES during the first three months of this year are reported by a prominent manufacturer as being slightly better than for the same period last year. Another large manufacturer says that supply business to date is better than it was for the same time last year. From other sources come similar reports. There is a steady flow of business being transacted by those companies who are making aggressive sales efforts. Industrial plants are buying in fair volume and are especially turning their attention to labor-saving apparatus. Central-station companies are purchasing apparatus and supplies steadily but have not yet entered the market in the large volume anticipated. The Westinghouse Electric & Manufacturing Company has announced the receipt of orders for induction feeder regulators, totaling over $500,000, from a number of large electric public service companies. The General Electric Company has this week reduced the prices of its line of induction motors.

Judge Elbert H. Gary, chairman of the board of the United States Steel Corporation, said this week that there is nothing in the general business situation to cause doubt to manufacturers or merchants over the outlook for continued prosperity and that the fundamental conditions of the country at the present time are the best in its history. Steel consumption continues good, and while buying has decreased, it is still in good amount. Production has declined somewhat.

In New England there is a general slackening of business, but sales for the first three months of 1925 show substantial gains in virtually all kinds of electrical supplies, as compared with the first quarter of 1924. An active interest has been shown in that territory in refrigerating units. Sales in the New York district consist of a large number of orders which in the aggregate are in good volume. In the Southeast business has shown improvement, particularly as regards the placing of orders for new construction. The location of new textile mills in that section is expected to result in many orders for electrical apparatus. Industrial plants have been increasing their purchases in the Middle West, and various central-station companies have been actively buying construction material. On the Pacific Coast weather conditions have delayed building construction, and motor business is good but hampered considerably by credit conditions.

Metal Market Quiet, but Sentiment Has Improved

COPPER has been substantially unchanged in price, but lead, zinc and tin all reached new low levels for the current movement. On Tuesday and Wednesday sentiment improved and prices, except for lead, tended to advance, though consumers continue to show little interest in the market, apparently waiting to see if the strength is going to be maintained. Buying has apparently been on a hand-to-mouth basis since the first of the year. Nearly all copper producers report less business than the previous week, with only occasional small sales in the domestic market, largely for April or May shipment.

The contract price of the American Smelting & Refining Company was reduced on April 7 to 8¼ cents. Sales of lead were light for most producers with one exception, this producer booking a substantial tonnage nearly every day. Lead was sold during the week at marked concessions below the contract price. Consumers seem to require immediate shipment for all orders.

NEW YORK METAL MARKET PRICES

	April 1, 1925 Cents per Pound	April 8, 1925 Cents per Pound
Copper, electrolytic	13¼	13.55–13¼
Lead, Am. S. & R. price	8¼	8¼
Antimony	14¼	13¼
Nickel, ingot	31	31
Zinc, spot	7.40–7.475	7¼
Tin, Straits	52¼	51⅛
Aluminum, 98 to 99 per cent	28	28

Base copper price April 8, 1925, 16 cents.

Fan Sales Expected to Increase This Year—Trade Optimistic

A FAIR degree of optimism among buyers is being noted by fan manufacturers despite the unseasonable weather experienced throughout the northern half of the United States during the summer of 1924. The fan season has not yet progressed far enough to permit a definite statement to be made with any assurance of its being correct, but as the volume of initial orders appears to be increasing and as many contracts have been signed with the usual promptness, manufacturers are anticipating a good year. It is believed that the demand will be better than last year by about 10 per cent to 15 per cent.

In the South dealers have been quick to sign fan contracts calling for substantial initial stocks as surplus stocks in that territory are not so large as in the North, and an early demand for stock shipments is expected.

Stocks of fans in the hands of jobbers and dealers in the Northern and Eastern sections of the country are believed to be large owing to the carry-over last year. Manufacturers' stocks are considered quite liberal and are heavier than usual. Production schedules appear to be evenly divided between those which are below normal and those which display a slightly increased rate as compared with last year's figures, and most manufacturers are arranging to care for an increased demand. Present deliveries are, of course, quite prompt, and no difficulties are anticipated. There is no prospect of any radical price changes during the season. The price trend is stationary, with an apparent desire on the part of all manufacturers to make reductions.

One manufacturer reports that he has adopted a 14-in. fan as a standard instead of making 12-in and 16-in. sizes as is customary with other manufacturers, and from the response already received he looks forward to a large volume of orders for this size. This company is concentrating on the manufacture of two sizes only. The belief is expressed from some quarters that entirely too many different sizes and types of fans are being manufactured—a condition that increases the stocks which jobbers and dealers must carry.

General Electric Reduces Prices on Induction Motors

THE General Electric Company has announced an average reduction of 10 per cent on standard types of polyphase induction motors in sizes from 1 hp. to 15 hp. inclusive and an average of 4 per cent in sizes from 15 hp. to 100 hp. inclusive, both effective since April 6. In making the announcement J. G. Barry, vice-president, said: "These motors are used to the extent of millions of dollars per year in factories and workshops. Improvements in design, in standardization and in processes of manufacture have produced lower costs, making this reduction in price possible."

Sales in New York District Mainly Small but Volume Good

SALES in the New York district are made up of a number of small orders which in the aggregate are in good volume. Business in many cases is not up to expectations, but, on the other hand, it is considered healthy and in several instances is reported as being equal to or better than last year. Industrial plants are placing small orders steadily and are showing interest in all labor-saving devices. Central-station companies have placed a number of orders for transformers, watt-hour meters, etc., but have not yet entered the market as heavily as expected for various equipment planned for purchase this year.

Jobbers state that sales have declined. Business is considered healthy. Competition among jobbers is very keen, especially for such commodities as conduit, wire, etc. Buyers are conservative and are purchasing only for current requirements.

Industrial Buying Increasing in the Middle West

THE volume of business in the Middle West fell off a trifle, but business remains quite active. The month of March closed well and indications point to excellent business for April. Heavier purchasing by industrial plants, equipment purchases by the railroads and activity in construction work by the various utility companies tend to increase the volume of business. Maintenance purchases have been good, and there is an excellent demand for pole-line hardware.

Jobbers report that sales of finishing materials for buildings have been excellent, but that the sale of roughing-in materials has not started in earnest as yet. Apparently the recent drop in the prices of code wire has not had much of an effect on the sales of wire

and the demand for conduit was quite satisfactory. Considerable interest is being aroused by one Chicago jobber in better window lighting attained by the use of floodlamps. One window has been fitted up with a line of merchandise and is stimulating sales of this equipment. Prices remain generally firm.

Sales Show Improvement in the Southeast—Outlook Good

THERE has been some improvement in electrical business in the Southeast, particularly as regards the tendency to place orders for new construction which has been held in abeyance for some time past. Industrial activities continue somewhat spotty and purchases generally, excepting central-station orders, are confined mostly to small contractors. This class is placing reasonably satisfactory orders for armored conductor, wire, conduit and similar materials. There is a scattering of orders for heavy materials going into industrial construction. Socket-device sales have not increased as much as was anticipated for the territory generally, but in some sections there is considerable activity in this line. Several large central-station companies are planning campaigns during April on washing machines, vacuum cleaners, flatirons and ranges, and these lines should be materially stimulated.

Central-station purchases of transmission-line materials and high-tension equipment continue satisfactory, one jobber reporting the receipt of an order this week for 250 miles of guy strand. Telephone equipment is in active demand, particularly in Florida. Electric truck sales are improving, twenty-seven vehicles having been recently sold in Atlanta. Twenty-five of these trucks go to one purchaser, and it is anticipated that this fleet will be augmented by twenty-five additional trucks within the next few months. The tendency of Eastern mill owners to relocate textile mills in the South is becoming more noticeable, as exemplified by the announcement by the Brighton Mills, Passaic, N. J., of the proposed establishment of a large spinning mill in north Georgia. Several other important projects are pending and will probably be closed within the next few weeks. This will mean heavy purchases of electrical materials as all of these mills will probably adopt individual electric drive throughout.

New England Displays Interest in Small Refrigerating Units

WHILE a general slackening in sales of electrical supplies seems to have prevailed throughout New England during the last week, the record of the first three months of 1925 shows substantial gains in sales of practically all kinds of electrical supplies as compared with the first quarter of 1924. Two striking gains are of interest. Kelvinator sales have increased 300 per cent in southeastern Massachusetts and an unusual activity in selling these units is reported in Maine. A manufacturer of central-station and transmission-line supplies also records a 75 per cent increase in sales to date as compared with last year.

The jobbing business is dull and few sales are reported. Among the sales is one by a prominent firm for 1,000 chestnut poles for a Massachusetts central-station company, amounting to $20,000. The demand for circuit breakers is active and the sales of domestic appliances continue quite strong. Fourteen central-station companies sold appliances amounting to $16,210 for the last week as compared with $10,176 for the previous week, with portable lamps, electric irons, kitchen units and cleaners most active. This same group shows sales of electrical appliances amounting to $157,456 to date as compared with $123,246 for a similar period in 1924. Lighting contracts and residential fixtures are moving well in outlying towns and cities in New England. In Boston general electrical construction is likely to slacken owing to the decision of the local electricians' union to strike.

Weather Delays Building Work on Pacific Coast—Sales Fair

UNUSUALLY late and prolonged rains have retarded much of the new building construction work on the Pacific Coast and contracting business is hardly more than fair. Recent orders have included many for lead-covered cables and for large stranded bare copper wire. Recent special orders of importance are an elaborate hospital signal equipment for the Eureka lumber district and 500 furnace transformers for San Francisco. The San Joaquin Valley irrigation projects have ordered several good assortments of general wiring and line supplies. Motor business is good but hampered considerably by credit because farmers in some sections are heavily in debt. A recent order received covered 100 large switches and equipment for pumping-plant control. The Sacramento Valley is especially promising for fall sales.

Appliance business has been stimulated by some new low-list cleaners, one manufacturer having supplemented his sixty-dollar model with a forty-five-dollar style. Good fan business is reported from eastern Oregon and eastern Washington, but at very close prices. There has been a 2½ per cent to 5 per cent price decrease in baking ovens and hotel ranges. Range campaigns of Puget Sound and the city of Seattle are progressing well, and predictions are optimistic for continued good results throughout the summer.

The General Electric Company was awarded a contract for furnishing thirty regulators to the city light department of Seattle for $38,880. The Centralia (Wash.) City Commission also awarded a contract to the Pacific States Electric Company, Seattle, for furnishing 7,000 lb. bare wire and 12,000 lb. weatherproof wire to connect the city's distributing system with the power plant being built by the Western Cross Arms & Manufacturing Company. The city of Tacoma has passed ordinances providing for the installation of ornamental lighting on several streets and has purchased 70,000 ft. of parking cable. Proposed additions and betterments to the city light distribution system have also been approved and are estimated to cost $95,000.

Activities of the Trade

Electric Truck Manufacturers Plan Promotion Campaign

Electric truck and battery manufacturers in co-operation with the Society for Electrical Development have planned a promotion campaign for 1925. A well-defined program of sales promotion, dealing with the preparation and distribution of special articles for trade journals and newspapers and special studies dealing with the logical relation of central-station companies to the electric truck industry, will be put into effect during the year.

The program will be conducted under the direction of the following advisory committee: C. A. Ward, Ward Motor Vehicle Company, chairman; G. A. Freeman, Walker Vehicle Company; B. A. Kelley, Kelland Motor Car Company; G. H. Pride, the Autocar Company; W. S. Ward, Electruck Corporation; E. R. Whitney, Commercial Truck Company; W. Van C. Brandt, Electric Storage Battery Company; Raymond Zindle, Society for Electrical Development, secretary.

Westinghouse Forms Acceptance Corporation to Assist its Buyers

As an expansion of its service to electrical dealers and appliance manufacturers, the Westinghouse Electric & Manufacturing Company announces the formation of the Westinghouse Acceptance Corporation, a two-million-dollar enterprise to assist buyers of its products in the financing of time-payment sales of its apparatus. G. Brewer Griffin, recently manager of the Westinghouse automotive equipment department, will have active charge of the new company as vice-president and general manager. The Acceptance corporation was recently incorporated under the laws of the State of Delaware. All stock so far issued has been subscribed for by the Westinghouse Electric & Manufacturing Company.

Mr. Griffin's offices and operating forces are at the East End Trust Building, Pittsburgh. Branch offices will be opened in other cities as the requirements develop.

Weston Instrument Changes Its Sales Policy on Pacific Coast

The Weston Electrical Instrument Corporation, Waverly Park, Newark, N. J., announces that it has made a number of radical changes with respect to its sales policy on the Pacific Coast. F. E. Smith of San Francisco, the company's former representative for approximately thirty years, has decided to retire. Under the new arrangement three distinct territorial divisions have been made with sales representatives in charge of each. In the north the

corporation will be represented by the Western Electric Company, with headquarters in Seattle. The San Francisco territory, extending south to a line drawn across the state approximately midway between Fresno and Bakersfield, and the State of Nevada will be handled by J. H. Southard, 682 Mission Street, San Francisco, while the southern California territory and Arizona will be under the sales representation of the Special Service Sales Company, 502 Delta Building, Los Angeles, whose president is A. A. Barbera.

In addition to these three sales representatives, a well-equipped and adequate repair laboratory will be conducted in San Francisco, at 682 Mission Street, by A. Honeychurch, to render excellent repair service to all three sales divisions. This new line-up, which is already in effect, will furnish excellent technical and sales contact and increased service for all customers of the corporation on the Pacific Coast.

Westinghouse Merchandising Department Moves to Mansfield

All activities of the merchandising division of the Westinghouse Electric & Manufacturing Company will hereafter be directed from Mansfield, Ohio. J. S. Tritle, manager of the merchandising department of the company, will become general manager of this department. Mr. Tritle has moved his headquarters, with his entire staff, from New York to Mansfield. The majority of the articles comprised in the merchandising department are produced at the Mansfield works.

Heretofore the engineering and manufacturing operations have been supervised by officers at East Pittsburgh, while the sales activities have been directed from the merchandising headquarters in New York. All engineering work will now be conducted in Mansfield under the supervision of Mr. Tritle. Those engineers at East Pittsburgh who have been engaged on the products made in Mansfield will be moved to the Ohio plant. It has been recognized for a long time that such a change was desirable in order to obtain unified effort in the conduct of the business.

National Carbon Company Extends Service Facilities

The National Carbon Company, which has maintained an emergency brush-finishing plant for the past two years at 237 East Forty-first Street, New York City, has just moved into new quarters at 357 West Thirty-sixth Street. The new location provides larger quarters, which have become necessary to take care of the increasing volume of this class of service. This is one of four similar emergency stations maintained by the company as auxiliaries to its main factory in Cleveland, Ohio. The others are at Pittsburgh, Chicago and Cleveland.

The Standard Turbine Corporation, Scio, N. Y., announces the appointment of Edward P. Johnson, 841 David-Whitney Building, Detroit, as its district representative.

The Crocker-Wheeler Company, Ampere, N. J., announces the sale of the following apparatus to the Cochran Cotton Mills, Hawkinsville, Ga.: One 250-kva., three-phase, 60-cycle, 600-volt, 200-r.p.m. engine-type alternator with belted exciter and switchboard equipment and twenty-six three-phase, 60-cycle, 550-volt squirrel-cage motors. The alternator is to be driven by a Skinner engine.

The Electric Service Supplies Company, Philadelphia, announces the appointment of J. H. Spraggon to its sales force. Mr. Spraggon has been connected with the Westinghouse Electric & Manufacturing Company for twelve years and for the last six years has been selling in the New England territory for that company.

Porter & Ross, 30 Church Street, New York, manufacturers' agents, announce that they have been appointed representatives in the Eastern territory for the American Enameled Magnet Wire Company, Muskegon, Mich.

Fred J. Postel announces that he has disposed of the consulting engineering business of Fred J. Postel & Company to George A. Muir and Irving E. Brooks, consulting engineers, who will continue the business at their present address, 163 West Washington Street, Chicago, under the name of Muir & Brooks.

The General Electric Company announces the receipt of an order from the Farmington River Power Company, New Britain, Conn., for two 5,000-kva., 150-r.p.m., 2,300-volt vertical water-wheel-driven generators with direct-connected exciters. The order also includes seven 1,667-kva., 66,000-volt self-cooled transformers and complete automatic switching equipment. Seven 1,667-kva. step-down transformers and switching equipment were also ordered for use in a substation in New Britain.

The Square D Company, Detroit, manufacturer of electrical safety devices, announces the removal of its New York office to the Building Loan Building, Room 1108, 441 Lexington Avenue.

The R. Thomas & Sons Company, East Liverpool, Ohio, manufacturer of Thomas Hewlett insulators, has published the first issue of *Thomas Topics.* It is referred to as an organ of facts and gossip dedicated to the electrical industry and will be published monthly.

The Thos. J. Corcoran Lamp Company, Winton Place, Cincinnati, announces that it is now manufacturing a 600-watt electrical heater of the bowl reflecting type, known as the "Scat-R-Heet."

The Westinghouse Electric & Manufacturing Company is expected soon to establish a branch office at Tampa, Fla. W. S. Rugg, general sales manager at Pittsburgh; H. A. Coles, district manager at Atlanta, and W. W. Ballew, Central States manager, were in Tampa recently, and looked over probable sites for a warehouse. The understanding is that a combination office and warehouse building will be built. Mr. Rugg said that Florida business had become so heavy it was necessary to have a distributing point in the state, and that Tampa, with its excellent port facilities and its proximity to the growing west coast, is considered a desirable point.

New Equipment Available

Trough for Service-Entrance Switches

A new type of trough for connecting adjacent "Noark" service-entrance switches has been developed by the Johns-Pratt Company, Hartford, Conn. The trough, as heretofore, is designed for fitting into U-shaped "knock-out" openings in the switch cabinets. Right-angle flanges are provided at the ends of the troughs and two guides are stamped into the trough at each end. The trough is slipped into the U-shaped openings of the adjacent cabinets and the flanges and the guides engage the walls of the cabinet on either side. A bonding screw is located at each end of the trough for the purpose of enabling it to be fastened to the adjacent cabinets. Snap-on covers are provided and each trough has a ½-in. "knock-out" in each side.

Automatic Welders

A line of automatic arc-welding equipment has been developed by the General Electric Company whose principal application is in the construction of such standard products as transformer and other tanks, boilers, cans, axle housings, etc., where the static load is not greater than 10 lb. per square inch and where the thickness of the metal to be welded is not less than No. 16 gage. These equipments, sold either as complete units or as separate parts, have been especially designed for quick, efficient and economical welding where quantity production is a factor.

A complete outfit consists of an automatic welding head and push-button control panel, travel carriage and clamping device. Where it is desired, in order to meet special circumstances in any plant, the travel carriage and other component parts of the equipment may be assembled by the purchaser with his own device for holding the work.

Globe Holder. — A globe holder, designed to eliminate globe breakage and to economize in the maintenance of ornamental lighting systems, known as the "Jiffy," has been placed on the market by the Westinghouse Electric & Manufacturing Company. This device permits the removal of the globe almost instantly and provides quick relamping. By shifting a lever a catch is released and the globe is easily lifted out. It is also easily replaced, but can only be reopened by manual means as the device locks automatically.

New Trade Literature

ELECTRIC MOTORS.—The U. S. Electrical Manufacturing Company, 583 Howard Street, San Francisco, is distributing a folder covering the "U. S." automatic-start motor, which is a self-starting motor with no moving parts in the starting mechanism.

CENTRAL-STATION LOAD INDICATORS.—Charles Cory & Son, Inc., 183 Varick Street, New York City, has issued bulletin 104-29-B containing a description of the Cory load-indicating systems for automatic or manual control. Illustrations are also given showing various types of load and period indicators, manual controls and totalizing wattmeter-operated automatic control.

BALL BEARINGS.—The New Departure Manufacturing Company, Bristol, Conn., is distributing a folder calling attention to the advantages of the use of ball bearings with electric motors.

REFRACTORIES. — "Refractories and Furnace Design" is the title of a new catalog issued by the Plibrico Jointless Firebrick Company, Kingsbury at Clay Street, Chicago, covering the Plibrico furnace lining. A large section is devoted to the proper installation of monolithic furnace linings. Attention is also called to the use of this lining for furnace fronts, arches, side walls and bridge walls in boiler furnaces, baking ovens, stills and other industrial furnace applications.

MACHINE-MOLDED GEARS. — The Poole Engineering & Machine Company, Baltimore, Md., has issued a new bulletin entitled "Do You Know How Poole Gears Are Made?" which describes and illustrates the Poole method of making machine-molded gears and gives the details concerning how the high degree of accuracy of the gears is obtained.

LIFTING MAGNETS.—The Ohio Electric & Controller Company, 5,900 Maurice Avenue, Cleveland, Ohio, has issued bulletin No. 107 covering the Ohio lifting magnets and discusses their use in the iron and steel industries, also for magnetic separation of tramp iron from ore, cement, coal, etc. It contains illustrations showing various applications for handling pipe in warehouses, rails, billets, etc., as well as iron, steel and scrap in bulk.

ELECTRIC LOGGING EQUIPMENT.—The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has issued bulletin L-1,702 covering the Westinghouse electric logging equipment. It calls attention to the advantages of electric logging and contains illustrations showing the various types of electric logging equipment, including loader, yarder unit, duplex loader unit, car-mounted electric donkey, etc.

VENTILATING FANS.—The Ilg Electric Ventilating Company, 2850 North Crawford Avenue, Chicago, is distributing a folder calling attention to the advantages of the use of the Ilg ventilating fans in offices, stores, factories, theatres, public buildings, etc.

OHMMETER.—Bulletin No. 1,070 issued by James G. Biddle, 1211 Arch Street, Philadelphia, describes the "Meg" ohmmeter, which is a direct reading instrument for measuring high ohmic resistance and for testing the insulation resistance of certain types of electric apparatus in laboratory and production processes where a suitable direct-current operating voltage is available.

SOLDERLESS CONNECTORS.—Dossert & Company, 242 West Forty-first Street, New York City, has issued catalog No. 20 covering the Dossert solderless connectors for stranded and solid wires, rods and tubing. It contains price lists, dimensions and other useful information.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number:

An agency is desired in Rio de Janeiro, Brazil (No. 14,310), for electrical automobile appliances, radio sets and equipment.

An agency is desired in Wellington, New Zealand (No. 14,308), for all kinds of household electrical appliances.

An agency is desired in Sydney, Australia (No. 14,313), for insulating material to be molded into shape, high-tension insulators (pin type) and porcelain brushings and electric meters. Purchase is desired (No. 14,311) of motor-generator sets.

An agency is desired in Alexandria, Egypt (No. 14,300), for radio sets and equipment.

An agency is desired in Kovno, Lithuania (No. 14,312), for radio sets and equipment.

Purchase is desired in Swansea, Wales (No. 14,314), of radio sets, tubes and crystals.

An agency is desired in Alexandria, Egypt (No. 14,349), for creosoted poles, 23 to 30 ft. in length, and railway ties.

FIRE-ALARM OPPORTUNITY IN SOUTH AMERICA.—An important city in South America, which at present has an unreliable fire-alarm signal system, *Commerce Reports* states, is favorably inclined toward the installation of an efficient and reliable signal apparatus.

New Incorporations

THE CARTERSBURG & MONROVIA ELECTRIC COMPANY, Cartersburg, Ind., has been incorporated by Joseph W. Dale, George Waterous and Charles Burt. The company is capitalized at $25,000 and proposes to distribute electricity in Cartersburg, Monrovia and vicinity.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

FORT WARREN, MASS.—Bids will be received by the Quartermaster, Boston Harbor, until April 13, for 159 watt-hour meters (Circular 46).

DEVON, CONN.—Plans are being considered by the Connecticut Light & Power Company for extensions to its local plant with a view of increasing the ultimate capacity to 200,000 kw. The present output is 67,500 kw. and the first step will be the installation of an additional unit increasing the capacity nearly 50 per cent.

Middle Atlantic States

BUFFALO, N. Y.—The City Council has authorized the purchase of 1,000 electric lamp standards, to cost $42,000, and 1,000 parkway lamps, to cost $26,870, to be erected in different parts of the city.

HIGHLAND, N. Y.—The Public Service Commission has granted the Tusten Light & Power Company, Narrowsburgh, permission to exercise franchises granted by the towns of Highland and Cochecton and to erect the necessary transmission and distribution lines to serve the territory. The company proposes to erect about 18 miles of 4,600 volt lines in Highland and about 3 miles of 11,000-volt line and 7 miles of 4,600-volt line in Cochecton. To insure service all the year around the company will make connection with the lines of the New York State Gas & Electric Company, Ithaca.

OLEAN, N. Y.—The Niagara, Lockport & Ontario Power Company, Buffalo, has applied for permission to acquire the property of the Olean Electric Light & Power Company. Plans are under way for transmission line extensions in this section.

STATEN ISLAND, N. Y.—Bids will be received by the Superintendent of Lighthouses until April 14 for ten radio fog signal transmitter control panels, complete with meters, switches, etc. (Proposal 19041).

SYRACUSE, N. Y.—The Lennox Furnace Company, Marshalltown, Iowa, plans to build a power house in connection with its proposed local plant.

WATERTOWN, N. Y. — The Northern New Utilities, Inc., has petitioned the Public Service Commission for permission to erect a transmission line in the towns of Western, and Lee to serve the hamlets of Northwestern, Westernville and Lee Center.

BELLE MEADE, N. J. — The Public Service Electric & Gas Company, Newark, has secured permission to acquire the property of the Belle Mead Electric Light & Power Company. Extensions in transmission lines in this section are contemplated.

JERSEY CITY, N. J.—The Public Service Electric & Gas Company, Newark, has filed plans for the construction of a substation at Duffield Street, and Van Keuren Avenue, to cost about $150,000.

NEWARK, N. J. — The Public Service Electric & Gas Company of New Jersey has approved plans for further extensions and improvements of its electric transmission and distribution systems during 1925, involving an expenditure of about $30,000,000. The plans also provide for further connections with neighboring electric systems, including additional connection with the Philadelphia Electric Company, from which the Public Service Company will transmit energy to a large new substation at Trenton; the laying of two cables on the bed of Arthur Kill between Perth Amboy and Staten Island shore for interchange of power with the Staten Island Edison Company; to increase the supply of power in the Camden district the span cable which now ties in with the Philadelphia Company across the Delaware, will be carried in conduit to the Camden station; transmission lines to be carried on steel towers, will tie in the Passaic and central divisions with the new Kearny plant; fourteen additional transmission cables in conduit are provided to strengthen the service in Essex and Hudson Counties; new transmission lines from Marion station to Hackensack and thence to Westwood will be erected; in the southern division new lines will be erected from Camden to Chester, strengthening the existing lines between Camden and Woodbury and the reinforcement of lines in the vicinity of Trenton and Princeton; new substations will be erected at Perth Amboy and South Paterson and extensions made to substations at Hoboken, Washington Avenue, Newark, and Liberty Street, Trenton; a further addition will be made to the Seventh Street substation, West New York, and a 5,000-kw. synchronous condenser will be installed at the Plainfield substation.

PERTH AMBOY, N. J.—Mayor William C. Wilson has approved an appropriation of $45,000, for the electrification of the Runyon water plant.

CARBONDALE, PA.—The Delaware & Hudson Railroad Company, 32 Nassau Street, New York, plans to install electric power equipment in connection with the rebuilding of its local shops, recently destroyed by fire, with loss of about $175,000.

HAZLETON, PA.—Plans are under way for the installation of a new ornamental lighting system on North Wyoming and South Wyoming Streets. The plans provide for forty-one lamps of 400 cp.

MONTROSE, PA. — The Susquehanna County Light & Power Company has applied for permission to organize and operate seveteen subsidiary companies, to construct transmission lines in different sections of Susquehanna County.

AMHERST, VA.—The Lynchburg (Va.) Traction & Light Company is considering the installation of a local light and power system.

NORFOLK, VA.—The Yorco Power Company, Inc., Dickson Building, Norfolk, which distributes electricity in a number of towns in York County, contemplates extending its transmission line 15 miles in York County. Energy is purchased from the Newport News & Hampton Railway, Gas & Electric Company, Hampton. Henry B. Reardon, Jr., is president and manager.

WASHINGTON, D. C.—Bids will be received by the Chief Signal Officer, United States Army, until April 20, for two telephone switchboards (Circular CP 20353-1).

North Central States

MINDEN CITY, MICH.—The City Council plans to install a municipal electric lighting system.

CANTON, OHIO.—The Ohio Power Company contemplates improvements to its transmission lines and increasing the capacity of its distribution system in the southwest section, at a cost about $200,000.

CLEVELAND, OHIO.—Bids will be received at the office of the Commissioner of Purchases and Supplies, City Hall, until April 17 for lead covered cable for the Division of Light and Power.

CLEVELAND, OHIO.—Extensions to the municipal electric plant, involving an expenditure of about $1,000,000, will be sub-

mitted to the City Council for approval. The work will include a new substation in Windsor Avenue, on the East Side; and one on Scranton Road, on the West Side; addition to substation in West Fourteenth Street, extension of cables in the Collinwood district, and new ornamental lighting systems to cost about $300,000, the locations to be determined later; also the completion of intake and discharge water tunnels at the main plant and addition to the plant to provide space for machine shop and storage.

LORAIN, OHIO.—The Ohio Public Service Company contemplates erecting a substation along the New York, Chicago and St. Louis railroad tracks on the east side and also along the Baltimore and Ohio Railroad tracks at East Twenty-first Street, to cost about $50,000.

MIDDLETOWN, OHIO.—Plans are under consideration for extension of the ornamental lighting system from the Miami and the Erie Canal east to the Big Four station. The installation of ornamental lamps on Canal Street is also being discussed.

HORSE CAVE, KY.—Surveys are being made by the Kentucky Utilities Company, Louisville, for the erection of a high-tension line from Horse Cave to Campbellsville. The proposed line will connect the power plants of the company in Eastern Kentucky and Western Kentucky. The present line from Horse Cave to Glasgow, which now carries 11,000 volts, will be rebuilt for 33,000 volts.

COLUMBIA CITY, IND.—Bids will be received by the City Council until April 16 for equipment for the municipal electric plant, including a uniflow-type engine, vertical jet condenser, one 750-kva. and one 625-kva. generator, one nine-panel switchboard, etc. The cost of the work is estimated at $84,000. H. W. Jacobsen, 210 East Forty-sixth Street, Chicago, is consulting engineer.

GARRETT, IND.—Plans are under consideration for rebuilding the municipal electric light and power plant, including the installation of additional equipment, to cost about $80,000.

INDIANAPOLIS, IND.—Bids will be received by the Board of Sanitary Commissioners, City Hall, until April 23, for the erection of an electric transmission line for service at the municipal garbage disposal plant.

ABINGDON, ILL.—Plans are under way for the installation of an ornamental lighting system on Latimer, Adams and Jackson Streets, Pennsylvania and Ohio Avenues, consisting of sixty-four cast-iron poles. F. M. Connolly, Galesburg, is engineer.

CHICAGO, ILL.—Plans for the proposed new plant to be erected at 2555 West Taylor Street, to cost about $150,000 by the Kellog Box Board Company, Chicago, care of Moore & Neely, 219 East Superior Street, Chicago, engineers, include a power house.

CHICAGO, ILL.—A permit has been granted to the Board of Directors of St. Lukes Hospital, 1421 South Michigan Avenue, for the construction of a power plant at the institution, to cost about $100,000. C. C. Frost, 105 South La Salle Street, is architect.

CHICAGO, ILL.—The Belden Manufacturing Company, 4625 West Van Buren Street, has taken out a permit to build a substation at its plant.

JACKSONVILLE, ILL.—Plans have been approved by the Board of Local Improvements for the installation of an ornamental lighting system on West Beecher and West College Avenues and West Street and all intersecting streets from Webster Avenue to North Church Street.

LEWISTOWN, ILL.—The installation of an ornamental lighting system on North Adams, North and South Main Streets, West Lincoln and West Washington Avenues, is under consideration. F. M. Connolly, Galesburg, is engineer.

PERU, ILL. — Bonds to the amount of $90,000 have been voted for improvements to the municipal electric plant.

ST. PAUL, MINN.—Bids will be received by H. W. Austin, city purchasing agent, until April 14 for equipment for the Bureau of Lighting as follows: transformers; 31,000 ft. of 1,000-volt cable; 158 13-ft. single lamp standards and bronze lanterns.

ACKLEY, IOWA.—Extensions and improvements are contemplated to the municipal electric plant, to cost from $35,000 to $40,000.

BURLINGTON, IOWA.—The Mississippi River Power Company, Keokuk, plans to rebuild its transmission line between Fort Madison and Burlington, to cost about $200,000, as a supplementary to the Iowa Southern Utilities Company rebuilding of the Burlington system.

TAMA, IOWA.—The Iowa Railway & Light Company, Cedar Rapids, has been granted a franchise to make extensions to its transmission lines in Tama, including portions of the Townships of Grant, Buckingham and Geneseo, which will require about 40 miles of lines.

WATERLOO, IOWA.—Plans for extensions and improvements covering the territory from Independence to Spirit Lake served by the Central Iowa Light & Power Company, are under consideration, the work to be started as soon as weather conditions will permit.

CENTRALIA, MO.—The Chaunce Company plans to build a steam-operated electric power plant in Centralia, to cost about $80,000.

BEULAH, N. D.—The Knife River Coal Company, Bismarck, contemplates the construction of a new steel tipple and installation of power plant equipment at its local properties, and the erection of a 10-mile transmission line from Beulah to Hazen, to cost about $50,000. E. A. Hughes, Bismarck, is engineer.

BISMARCK, N. D.—Extensions and improvements contemplated by the Hughes Electric Company including the installation of a 1,250-kw. steam turbine unit, boilers, condensing apparatus and cooling pond, etc., to cost about $85,000. E. A. Hughes is engineer.

REDFIELD, S. D.—The State Legislature has appropriated $100,000 for the boys and girls home, $25,000 for addition to power plant, $15,000 for laundry, $40,000 for dairy, and $75,000 for hospital in Red field.

EMMET, NEB.—A bond issue of $8,000 has been approved for the installation of an electric lighting system.

Southern States

HALIFAX, N. C.—The Town Council has approved a bond issue for the installation of a municipal electric lighting system.

ROCKWELL, N. C.—The Rockwell Light & Power Company contemplates extending its transmission lines to Gold Hill and Misenheimer. C. A. Bost is manager.

ANDERSON, S. C.—The city of Anderson, we are informed, does not contemplate the installation of a municipal light plant as reported in the issue of March 28.

SUMMERVILLE, S. C.—The McCormack Light & Power Company contemplates the installation of a 200-kw. steam engine-driven generating unit. Robert R. Hall is general manager.

AUGUSTA, GA.—The Augusta-Aiken Railway & Electric Company has engaged the J. G. White Engineering Corporation, 43 Exchange Place, New York City, to design and construct an outside substation at Stevens Creek; also for alterations and additions to the Augusta substation and alterations and extensions to crossing towers and poles, telephone system, etc.

MACON, GA.—Weems & Company, Inc., P. O. Box 287, plans to build a hydro-electric power plant in connection with a new grain mill, to cost about $85,000.

ROSSVILLE, GA.—The National Processing Company, recently organized, plans to build a power plant in connection with a proposed local textile mill, to cost about $200,000.

SHANNON, GA.—Plans for the proposed local cotton mill of the Brighton Mills, Inc., Passaic, N. J., to cost about $1,000,000, include a power plant.

LAKELAND, FLA.—Bids will be received by the City Manager, City Hall, until April 16 for extensions to the municipal electric plant, including extensions to building, shifting and changing of turbines, etc. Equipment has been purchased.

TARPON SPRINGS, FLA. — The City Council is considering the installation of an ornamental lighting system in the business district.

CHATTANOOGA, TENN. — The City Council is considering extensions in the ornamental street-lighting system on Georgia Avenue.

CHATTANOOGA, TENN.—The Tennessee Electric Power Company has acquired the plants and systems of the Clinton, (Tenn.) Power & Milling Company and the Oliver Springs (Tenn.) Electric Light Company. Plans are under way for extensions in transmission lines.

CHATTANOOGA, TENN.—The Tennessee Electric Power Company is considering the installation of an underground conduit system in the business section to replace present overhead lines.

HUMBOLDT, TENN.—Extensions and improvements to the municipal electric power plant and waterworks, to cost about $75,000, are under consideration.

BIRMINGHAM, ALA.—Work will soon begin by the Alabama Power Company on the erection of a high-tension transmission line from Fulton Springs to Oneonta, a distance of 20 miles, to cost about $200,000.

BIRMINGHAM, ALA.—The Birmingham Electric Company has purchased a tract of 13 acres of land north of the city on which it proposes to erect a substation, to meet the increasing demand for power in North Birmingham, Tarrant City and Boyles.

ELBA, ALA.—The Pea River Power Company, Troy, contemplates extensions and improvements in its local power plant, to cost about $50,000.

FORT DEPOSIT, ALA.—The City Council is considering the installation of a municipal electric lighting system.

HALEYVILLE, ALA.—The City Council has accepted the offer of the Alabama Power Company for the municipal electric plant, subject to the approval of the voters. An election will be held April 30.

ROBERTSDALE, ALA. — The Deuel Power Company plans to move its plant from Loxley to Robertsdale and install a 56-hp. Fairbanks-Morse oil-engine-driven generating unit and also to erect a transmission line from Robertsdale to Silverhill and Summerdale. H. R. Deuel is owner and manager.

HARRISON, ARK.—Extensions and improvements contemplated by the Southwest Power Company, McAlester, Okla., include the installation of a 300 hp. oil engine, the erection of a 33,000-volt transmission line from Harrison to Rogers, Ark., a distance of 90 miles, and the construction of a 15-ton ice plant. V. M. Kellogg is general superintendent.

OKLAHOMA CITY, OKLA.—Steps have been taken by the Broadway Improvement Association for the installation of an ornamental lighting system on Broadway.

BEAUMONT, TEX.—Arrangements have been made between the Stone & Webster, Inc., 147 Milk Street, Boston, and the Western Public Service Company, Colorado Springs, Col., whereby a large electric power plant will be built and a transmission system erected that will cover practically all of southeast Texas, extending from the Louisiana line to points from 25 to 150 miles east and north of Houston. Under the proposed plans Stone & Webster, Inc., will extend its transmission line from Beaumont to Sour Lake, where it will connect with the system of the Western Public Utilities Company and supply energy to operate the properties of the latter in this section. In order to supplement this service the Western Utilities company will construct a large central station in the western part of the district that is to be served.

BOWIE, TEX.—The Texas Utilities Company has applied for permission to issue $3,000,000 in bonds, the proceeds to be used for extensions to its system. The company has acquired the property of the Slaton (Tex.) Power & Light Company, which will be connected up with its system in that section.

CUERO, TEX.—A petition has been presented to the City Council asking that an election be called to vote on the proposal to issue $150,000 in bonds to establish a municipal electric light and power plant.

LOCKHART, TEX.—Plans are under way by the Texas Power & Light Company, Dallas, for the erection of a transmission line from Taylor to Lockhart, a distance of 65 miles. The company has purchased the electric plant of the Citizens' Water & Light Company. Negotiations are pending for the purchase of plans in other towns in the territory through which the proposed line will traverse. To meet the increasing demands for service the company also plans to erect an additional power house either at Austin or Bastrop.

MALAKOFF, TEX.—Work will soon begin by the Texas Power & Light Company, Dallas, on the construction of large machine shops, to be located near its proposed electric power plant.

McKINNEY, TEX.—Plans for the proposed cotton mill to be built by the McKinney Cotton Mill Company, now being organized, to cost about $400,000, include a power plant. Dr. C. G. Comegys, and John H. Ferguson, both of McKinney, are interested in the project.

VICTORIA, TEX.—An election will be held May 12 to vote on the proposal to issue $65,000 in bonds to establish a municipal electric light and power plant.

Pacific and Mountain States

CAMAS, WASH.—The Crown Willamette Paper Company, 248 Battery Street, San Francisco, Cal., plans to install electric power equipment at its proposed local mill to cost about $500,000.

LONGVIEW, WASH.—Plans for the proposed local lumber mill to be erected by the Weyerheuser Timber Company, Tacoma, to cost about $400,000, include a power house.

SPOKANE, WASH. — The Washington Water Power Company has applied to the State Department of Public Works for a franchise to erect transmission lines in Lincoln, Grant, Douglas, Chelan and Okanogan Counties from the Long Lake power station to substations at Stratford, thence to Brewster, via Coulee.

BAKERSFIELD, CAL.—Plans are under consideration by the Civic Commercial Association for the installation of an ornamental lighting system in the business district. W. D. Clarke is city engineer.

FRESNO, CAL. — Work will begin at once by the San Joaquin Power & Light Company on the construction of another hydro-electric plant to develop 37,500 hp. on the north fork of the Kings River, 50 miles above Fresno, to cost about $4,500,000. The new plant will be known as the Balch power house, and will be the first of unit of a chain of power houses, to cost about $50,000,000, to be eventually built along the Kings River.

GLENDALE, CAL.—The City Council is considering the installation of an ornamental lighting system on Broadway.

LOS ANGELES, CAL.—Bids will be received by the County Fire Warden, 904 Hall of Records Building, until April 27, for the installation of a fire alarm system in the Belvedere Gardens County Fire Protection District.

OAKLAND, CAL.—Steps have been taken by the Telegraph Avenue Development Association for the installation of an ornamental lighting system on that thoroughfare.

OAKLAND, CAL.—Plans for the proposed ornamental lighting system to be placed around Lake Merritt, in the heart of the city, provide for the erection of 128 electroliers, to cost $120 each; installation of the lamps will cost $71,000.

RIVERSIDE, CAL.—The Southern Sierras Power Company contemplates extensions and improvements in its system to cost about $465,000.

SAN DIEGO, CAL. — Steps have been taken by the Mission Beach Improvement Club for the installation of an ornamental lighting system in the Mission Beach district.

SAN MATEO, CAL.—The Board of City Trustees is considering the installation of an ornamental lighting system on Griffith Avenue.

BUTTE, MONT.—Investigations are being made by the Montana Power Company regarding an irrigation project for the Marias River, near Loma, and another on the Missouri River, below Loma. The plans include the installation of electric pumps.

Canada

ARNPRIOR, ONT.—Surveys are being made by the Hydro-Electric Power Commission of Ontario for a 66,000-hp. hydro-electric development on the Ottawa River, at Roche Rende, near Arnprior, to cost about $5,000,000. F. A. Gaby is chief engineer.

TIMMINS, ONT.—Plans are under way to enlarge the properties of the Hollinger Consolidated Gold mines, increasing the daily capacity from 4,000 to 8,000 tons. The cost of the work is estimated at $3,000,000 and will include new tube and ball mill, filters, hoisting apparatus, electric motors, conveyors, pumps, elevators, etc.

TORONTO, ONT.—The Hydro-Electric Power Commission of Ontario, Toronto, is considering making investigations of a proposed water power development on Cataraqui River, Leeds County. The cost is estimated at $750,000.

CHICOUTIMI, QUE.—Plans are being prepared by the Chicoutimi Electric Company for the construction of a hydro-electric plant, including dam, etc., to cost about $500,000. H. Cimon, 144 Grand Allee, Quebec, is engineer.

ST. ANNE DE BEAUPRE, QUE.—The construction of a power plant, to cost about $50,000, is urder consideration by Energie Electric de Riviere des Chiens.

Electrical Patents

Announced by U. S. Patent Office

(Issued March 10, 1925)

1,529,450. BATTERY CLAMP; A. Schulte, Quincy, Ill. App. filed Nov. 6, 1922.

1,529,455. ELECTRICAL OSCILLATOR; F. K. Vreeland, Montclair, N. J. App. filed May 3, 1920. Of the regenerative type.

1,529,473. METHOD OF AND MEANS FOR TRANSMITTING PICTURES; M. Ferree, New York, N. Y., and J. Wissmar, Cleveland, Ohio. App. filed Dec. 3, 1924.

1,529,475. ILLUMINATING MEANS FOR LIQUID LEVELS; T. Ford and Van Q. Flinn, Lexington, Ky. App. filed Feb. 7, 1924.

1,529,484. DEAD-FRONT SAFETY PANEL; G. W. Hyser, Minneapolis, Minn. App. filed Jan. 3, 1921.

1,529,520. COMMUNICATION-RECEIVING SYSTEM; J. O. Watkins, San Francisco, Cal. App. filed Sept. 19, 1921. To perceive signals produced by oscillations or waves, as electric undulations or sound waves.

1,529,522. ELECTRIC METER; R. S. White, Washington, D. C. App. filed July 5, 1924. Watt-hour meter.

1,529,549. SECONDARY OR STORAGE BATTERY; R. B. Owen, Washington, D. C. App. filed March 29, 1922. Means for providing a detachable connection between the terminal post of a battery cell and the cover thereof.

1,529,570. MAGNETIC PULLEY; J. P. Bethke, Milwaukee, Wis. App. filed June 10, 1921.

1,529,582. NON-SPILLABLE BOX OR CONTAINER; W. R. Edwards, London, England. App. filed July 13, 1923. For electric batteries.

1,529,597. ELECTRON-EMITTING DEVICE AND METHOD OF PREPARATION; I. Langmuir, Schenectady, N. Y. App. filed Aug. 11, 1921.

1,529,616. RELAY CONTACT AND METHOD OF MAKING THE SAME; F. L. Dodgson, Rochester, N. Y. App. filed Jan. 13, 1919. For relays used in railway signaling systems.

1,529,626. VACUUM ELECTRIC TUBE; E. Y. Robinson, Manchester, England. App. filed March 21, 1924. Electron-discharge type.

1,529,636. DYNAMO-ELECTRIC MACHINE; W. H. Powell, Milwaukee, Wis. App. filed Aug. 2, 1920. Adapted to operate as a direct-current or an alternating-current machine with a doubly reentrant compensating winding and means for short-circuiting.

1,529,638. ELECTROMAGNETIC SWITCH; H. W. Cheney, Milwaukee, Wis. App. filed April 7, 1921. Of the double-throw type.

(Issued March 17, 1925)

1,529,655. TELEPHONE SYSTEM; L. D. Kellogg, Deerfield, Ill. App. filed June 12, 1919. Two-wire or metallic line type.

1,529,675. ELEVATOR-MOTOR STARTING CONTROLLER; E. B. Thurston, Toledo, Ohio. App. filed Aug. 23, 1919.

1,529,681. BATTERY GRID; J. M. Allen, St. Louis, Mo. App. filed July 15, 1921.

1,529,700. AUTOMATIC TELEGRAPHY; E. S. Heurtley, London, England. App. filed April 9, 1923.

1,529,703. INSULATING MEANS FOR GALVANIC CELLS; H. W. Jones, Flushing, N. Y. App. filed May 9, 1924.

1,529,747. ELECTROPLATING APPARATUS; E. J. Mercil, Oak Park, Ill. App. filed Jan. 26, 1924. Of a class employing tumbling barrels.

1,529,761, 1,529,762. CONTROL SYSTEM; B. O. Austin, Wilkinsburg, Pa. App. filed April 12, 1921. For electric vehicles.

1,529,769. RELAY SYSTEM; C. A. Butcher, Wilkinsburg, Pa. App. filed Oct. 9, 1920. For preventing damage to synchronous converters.

1,529,773. FUSE BLOCK; H. J. Crabbs, Pittsburgh, Pa. App. filed June 10, 1922. For supporting expulsion fuses as used in high-potential circuits and mounted outdoors.

1,529,777. RELAY; R. D. Evans, Wilkinsburg, Pa. App. filed Oct. 17, 1918. Phase-responsive type.

1,529,786. SECRET COMMUNICATION SYSTEM; A. U. Harper, Evanston, Ill. App. filed April 2, 1920.

1,529,787. INDUCTION-MOTOR SYSTEM FOR LOCOMOTIVES; R. E. Hellmund, Swissvale, Pa. App. filed Aug. 26, 1918.

1,529,792. AUTOMATIC CONTROL SYSTEM; R. P. Jackson, Edgewood Park, Pa. App. filed May 10, 1922. Means whereby an instrument is caused to register only under certain conditions.

1,529,795. WINDING FOR DYNAMO-ELECTRIC MACHINES; M. F. Jones, Wilkinsburg, Pa. App. filed Nov. 23, 1922. Coils composed of deep, thin straps of copper and having an even number of straps per coil.

1,529,801. MULTIPLEX SUBMARINE CABLE; W. H. Martin, New York, N. Y. App. filed Jan. 22, 1921.

1,529,802. CONTROL SYSTEM; H. R. Meyer, East Pittsburgh, Pa. App. filed Dec. 2, 1922. For air-raised pantagraphs or other current-collecting devices.

1,529,822, 1,529,823. ELECTRIC LIGHTING FIXTURE; H. C. Adam, St. Louis, Mo. App. filed March 8, 1922.

1,529,839. SEPARATOR FOR STORAGE BATTERIES; E. Lunn, Chicago, Ill. App. filed May 11, 1921. Applicable to wood separators.

1,529,849. SIGNALING SYSTEM; Ely M. T. Ryder, Yonkers, N. Y. App. filed Sept. 7, 1922. In which a plurality of visible signals are used which are selectively operated in predetermined groups.

1,529,902. WATCHMAN'S SERVICE; D. R. Middleton, Detroit, Mich. App. filed March 16, 1922.

1,529,905. TROLLEY CONSTRUCTION; J. F. Montine, Chicago, Ill. App. filed June 27, 1923. In aërial tramway system for collecting and delivering mails, merchandise, etc.

1,529,910. GRIP-HANDLE SWITCH FOR ELECTRIC DRILLS; R. A. Norling, Aurora, Ill. App. filed Oct. 7, 1920.

1,529,922. ELECTRIC FLATIRON; T. C. Russell, Chicago, Ill. App. filed Aug. 8, 1923.

1,529,923. ELECTRIC SPACE HEATER; T. C. Russell, Chicago, Ill. App. filed Oct. 12, 1923. Long, flat, metallic sheath type.

1,529,934. TRANSFORMER ECONOMIZER; C. C. Tessier, Garner, Iowa. App. filed Nov. 5, 1921. Effectually to prevent core loss in the transformer when it is not in use.

1,529,943. PROCESS FOR OBTAINING METALS HAVING A HIGH MELTING POINT, SUCH AS TUNGSTEN; A. C. De Rouvre, Paris, France. App. filed March 7, 1923.

1,529,953. SELECTOR; C. A. W. Hultman, Djursholm, Sweden. App. filed May 16, 1922. As used in automatic telephone systems.

1,529,970. METHOD OF AND APPARATUS FOR THE MAGNETIC SEPARATION OF MATERIALS. G. Ullrich, Magdeburg, Germany. App. filed July 13, 1923.

1,529,973. ELECTRICAL COIL; C. R. Underhill, New Haven, Conn. App. filed Jan. 14, 1921. Construction of multi-layer coil.

1,529,978. TELEPHONE-EXCHANGE SYSTEM; R. S. Wilbur, Lyndhurst, N. J. App. filed Dec. 14, 1920. In which toll connections are established between exchanges by means of machine switching equipment controlled over toll lines.

1,529,993. COOLING DEVICE FOR STATORS OF ELECTRIC MACHINES; P. Ehrmann, Paris, France. App. filed March 18, 1921.

1,530,011. ELECTRICAL CONNECTING DEVICE; L. G. Pacent, Winfield, N. Y. App. filed March 20, 1923. Spring jacks.

1,530,030. ATTACHMENT PLUG; T. A. Both, Stratford, Conn. App. filed May 28, 1921.

1,530,063. SUPPORTING COLUMN FOR X-RAY TUBES AND ANALOGOUS MEMBERS; F. Tichy, Astoria, N. Y. App. filed Sept. 2, 1922.

1,530,089. SURGICAL BAKER; H. Perlman, Philadelphia, Pa. App. filed March 15, 1922. Application of heat derived from electric lamps to the limbs or other part of the body.

1,530,114. ELECTRIC LAMP SOCKET; M. J. Gretsch, New York, N. Y. App. filed Sept. 20, 1919. Pull-chain type.

1,530,120. CIRCUIT BREAKER; W. Hoopes, Pittsburgh, Pa. App. filed Oct. 4, 1922. For circuits having a voltage of 10,000 and upward,

1,530,129. RADIO SIGNALING SYSTEM; E. H. Loftin, Washington, D. C. App. filed April 5, 1920. Using types of antennas known as "low horizontal."

1,530,149. ELECTRIC CONTACT; W. E. Williams, San Francisco, Cal. App. filed April 4, 1923. Actuated by the opening of a door.

1,530,169. RADIO SIGNALING SYSTEM; W. F. Grimes, Washington, D. C. App. filed June 7, 1923. Apparatus for controlling the frequency of the system.

1,530,172. SYSTEM OF MOTOR CONTROL; K. L. Hansen, Milwaukee, Wis. App. filed Jan. 14, 1922. For loads of relatively high inertia having frequent operating intervals.

1,530,176. SPEED-CONTROL APPARATUS; H. C. Hayes, Washington, D. C. App. filed June 30, 1924. For giving constant speed by means of a tuning-fork control.

1,530,199. ELECTRICAL CURLING-IRON HEATER; A. H. Opperman, Indianapolis, Ind. App. filed July 25, 1923. Portable.

Financial and Corporate

Utility Stocks Advance

Best Gains in Weeks Are Shown as Trading Assumes a Better Tone

SIGNS of distinct improvement are beginning to appear again in the market for unlisted power and light stocks. In the week under review few of the issues made spectacular gains, but the whole tone of trading was better than it had been for some time and the price changes in most instances left stocks in a stronger position. The utilities market in some respects has done better lately than the general market, for its improvement comes at a time when issues of other groups are still more or less marking time.

Interest is turning again to Adirondack Power & Light Company's stock, which by the close of business on Monday had established a new high at 49, thus recording a ten-point advance for the week, or more than was shown by any other stock actively traded in. While the company's large investment in plant over recent years is certain to be reflected in earnings to an increasing extent from now on, talk of a merger of New York State properties, among which Adirondack and Power Corporation of New York have been named, is adding to the attractiveness of the stock now from a trading standpoint. Power Corporation of New York, incidentally, improved its position by three points during the week.

Vague rumors of a possible consolidation of Commonwealth Power Corporation and Tennessee Electric Power are cited in connection with the strong advance during the week in these two stocks. Commonwealth improved its position by six points and Tennessee by five. There has been no official statement that would justify any further conclusion than that the rise is explained by the favorable outlook for these companies this year. Georgia Light, Power & Railways advanced eight points to between 55 and 60. Gains of a point or two were numerous in the list.

Illuminating Securities Company Formed

Coincident with the offering of $2,000,000 additional preferred stock of the Cleveland Electric Illuminating Company comes the announcement of the formation of the Illuminating Securities Company, capitalized at 5,000 shares of no par common, all held by the Illuminating company. Robert Lindsay is chairman, E. G. Crawford president, Charles W. Mills vice-president and treasurer and R. H. Smith secretary. These officers, with H. W. Hough, constitute the board of the securities company. All are connected with the Illuminating company.

The securities company was formed to accommodate present and future owners of the securities of the Illuminating company. These include more than 6,700 holders of Illuminating 6 per cent preferred stock, $10,000,000 of which was distributed in ten months of 1923-1924 under the customer-ownership plan.

A New Holding Company

A new public utility holding company has been organized under the laws of Delaware known as the Midland Utilities Company, owning or controlling properties which serve 118 communities in Indiana and Ohio. The company is managed by Samuel Insull and associates and the Commonwealth Edison Company, The People's Gas Light & Coke Company, Public Service Company of Northern Illinois, Middle West Utilities Company and the United Gas Improvement Company hold practically all of the outstanding common and preferred stock of the company.

The operating companies which are the principal subsidiaries of the Midland Utilities Company are the Northern Indiana Gas & Electric Company, Calumet Gas & Electric Company, Calumet Power Company and several gas and traction properties. Subsidiaries of the company had gross earnings of $12,172,588 in 1924 and sold 142,699,786 kw.-hr. of electricity. The first piece of financing done by the company was the recent offering of its 7 per cent cumulative prior lien stock.

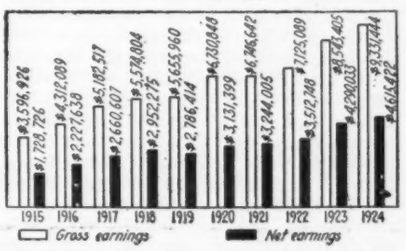
Utah Power & Light in New Utility Group

This Western Organization, Now an Operating Subsidiary of the Electric Power & Light Corporation, Has Had a Rapid Growth

BY PAUL WILLARD GARRETT

THE Utah Power & Light Company is one of the more important operating companies that will be under control of the new Electric Power & Light Corporation. Other well-known companies that will be linked with Utah Power & Light as subsidiaries of the newly created holding organization are the New Orleans Public Service Inc., the Dallas Power & Light Company and the Idaho Power Company. The Utah Power & Light thus is supervised, under the direction and control of the company's board of directors, by the Electric Bond & Share Company.

An extensive and rapidly growing territory is served by the Utah Power & Light Company in Utah, southwestern Wyoming and southeastern Idaho. Through a subsidiary, the Western Colorado Power Company, it also serves an important section in southwestern Colorado. In addition the company has leased for a period of ninety-nine years the electric power and light and gas properties of the Utah Light & Traction Company, a company which incidentally is owned as to its capital stock by the Utah Power & Light Company. Through this lease and through property directly owned the Utah Power & Light Company now does the entire electric power and light business in Salt Lake City and the entire electric power and light and gas business in Ogden. While the system has both hydro-electric and steam stations, the proportion of the former is substantially greater than that of the latter. The Utah Power & Light Company, together with the Western Colorado Power Company, owns hydro-electric generating stations with a total installed capacity of 150,550 kw. and steam electric generating stations with a total installed capacity of 21,900 kw. Taking into account all stations owned and leased, the system has a total installed generating capacity from the hydro-electric stations of 165,000 kw. and from the steam of 37,900 kw., or 202,900 kw. altogether. Roughly 90 per cent of the company's total output in 1924 was generated at hydro-electric plants, the steam stations being maintained largely as reserves. Additional capacity is under construction.



GROWTH OF UTAH POWER & LIGHT GROSS EARNINGS IN LAST DECADE

GROWTH IN THE LAST DECADE

Gross earnings of the Utah Power & Light Company have shown an unusual growth during the last decade, the total having increased from $3,596,926 in 1915 to $9,331,444 in 1924. Earnings in each year were larger than those for the year before. Net earnings in the same period showed a persistent growth from $1,728,726 to $4,615,422. The electric output between 1915 and 1924 grew from 330,179,000 kw.-hr. to 749,653,000 kw.-hr.

Among the company's bonds appear the first mortgage 5's of 1944, which are authorized to the amount of $100,000,000 but are outstanding to the amount of $25,847,000. Notwithstanding the liberal limitation on bonds issu-

able under this mortgage, the company has, in keeping with modern tendencies, created another lien without fixed limitation. Only $6,000,000 of the company's first lien and general mortgage bonds have been issued to date, but presumably the mortgage will be the principal medium of financing in the future. One of the interesting provisions among Utah Power & Light mortgage requirements is the one with reference to a sinking or improvement fund. The mortgage provides for a sinking or improvement fund of 1 per cent of the amount of bonds outstanding each year on December 31 from 1916 to 1918, 2 per cent from 1919 to 1933 and 2½ per cent from 1934 to 1943.

Dividends Declared

The following quarterly dividends were announced by central-station companies and electrical manufacturing companies recently:

Name of Company	Per Cent	When Payable
Alabama Power, pf.	$1.75	Apr. 1
Arizona Power, 8% pf.	2	Apr. 1
Arizona Power, 7% pf.	1¾	Apr. 1
Arkansas Light & Power, pf.	1¾	Apr. 1
Canada Northern Power, pf.	1¼	Apr. 15
Cincinnati Gas & Electric.	1½	Apr. 1
Commonwealth Edison	$2	May 1
Consumers Electric Light & Power (New Ore.), com	3%	Mar. 26
Consumers Power, 6% pf.	$1.50	July 1
Consumers Power, 6.6% pf.	$1.65	July 1
Consumers Power, 7% pf.	$1.75	July 1
Consumers Power, 6% pf.*	0.50	May 1
Consumers Power, 6% pf.*	0.50	June 1
Consumers Power, 6% pf.*	0.50	July 1
Consumers Power, 6.6% pf.*	0.55	May 1
Consumers Power, 6.6% pf. *	0.55	June 1
Consumers Power 6.6% pf.*	0.55	July 1
Eastern Kansas Power, pf.	1¾	Apr. 1
Eastern Texas Electric, com.	$1.25	Apr. 1
Edison Electric (Lancaster)	3	Mar. 31
Florida Public Service, pf.	1¾	Apr. 1
Harrisburg Lt. & Pwr., com.	2½	Mar. 31
Harrisburg Lt. & Pwr., pf.	1¾	Mar. 31
Jersey Central Pwr. & Lt., ptc. pf.	1¾	Apr. 1
Kansas Electric Power, pf.	1¾	Apr. 1
Kentucky Utilities, pf.	1¾	Apr. 15
Lancaster County Ry. & Lt., com.	$1	Mar. 31
Lancaster County Ry. & Lt., pf.	1¾	Mar. 31
Louisville Gas & Electric, pf.	1¼	Apr. 15
Manchester Traction, Lt. & Pwr.	2	Apr. 15
Milwaukee Elec. Ry. & Lt., pf.	1¾	Apr. 30
Minnesota Elec. Distributing, com.	1	Apr. 5
Missouri Gas & Elec., 7% pf. lien.	$1.75	Apr. 15
Newburyport Gas & Elec.	$2	Apr. 5
Pittsburgh Utilities, com.	$1	May 1
Pittsburgh Utilities, com., extra.	...	May 1
Pittsburgh Utilities, pf.	3½	May 1
Pittsburgh Utilities, pf., extra	2½	May 1
Public Ser. Co. of No. Ill., 6% pf.	$1.50	May 1
Public Ser. Co. of No. Ill., 7% pf.	1.75	May 1
Public Ser. Co. of No. Ill., com. (par $100)	1.75	May 1
Public Ser. Co. of No. Ill., com. (No par)	1.75	May 1
Public Service Elec. Power, pf.	1¾	May 1
Sayre Electric, 7% pf.	1¾	Apr. 1
Standard Power & Lt., pf.	$1.75	May 1
Allis-Chalmers Mfg., com.	$1.50	May 15
Canadian Westinghouse	2	Apr. 1
Electric Controller & Mfg. com.	$1.25	Apr. 1
Electric Controller & Mfg., pf.	1¾	Apr. 1
Electric Vacuum Cleaner, com.	$1	May 1
Electric Vacuum Cleaner, pf.	1¾	Apr. 1
Hurley Machine, com.	$1	Apr. 18
Hurley Machine, com. (extra)	25c.	Apr. 18
Johns-Manville	75c.	Apr. 1
Pittsburgh Transformer, pf.	2	Apr. 1
Pittsburgh Transformer, com.	2	Apr. 1
Superheater Co.	$1.50	Apr. 15
Wagner Electric Mfg., pf.	1¾	Apr. 1

* Monthly.

Weston Electrical Instrument Report.—For the year ended December 31, 1924, the Weston Electrical Instrument Corporation reports net income of $379,079 after taxes and all charges, equivalent to $2.20 a share on outstanding 100,000 shares no-par class A stock and $1.20 a share on outstanding 100,000 shares no-par common stock. Balance sheet as of December 31, 1924, shows current assets of $2,073,550 and current liabilities of $122,729.

Annual Reports of Light and Power Companies

The annual report of the Public Service Corporation of New Jersey for the year 1924 shows marked gains in all directions. Net income amounted to $7,859,120 after charges and taxes, equivalent after preferred dividends to $6.57 a share earned on outstanding 824,040 common shares of no par value. These figures compare with $5,345,875, or $5.69 a share, on 600,000 shares outstanding in 1923. During a part of the year there was, owing to industrial conditions, a falling off in the demand for power, yet for the twelve months output of generating stations increased by 74,451,826 kw.-hr., or 7 per cent, and the power purchased by 38,865,535 kw.-hr., or 126 per cent, the combined output showing an increase of 10 per cent over the previous year. At the same time the number of customers as represented by meters in service showed an increase of 98,972, or 23 per cent, the total number of meters in service on December 31, 1924, being 525,578. Transmission and distribution capacity was increased and improved through new substations, the remodeling of existing stations, the increase of transformer capacity, progress in changing the distribution system from two-phase to three-phase, the construction of new transmission lines, extension of the underground system and general improvement in apparatus and equipment.

The consolidated statement of earnings of the Niagara, Lockport & Ontario Power Company and subsidiary companies for the year 1924 showed gross revenue from sales of electric power amounting to $5,971,740, as compared with $5,550,257 for 1923. Energy sold during the twelve-month period totaled 626,911,607 kw.-hr., as against 613,547,320 kw.-hr. during the previous year. More than $3,000,000 par amount of 7 per cent cumulative preferred stock was sold during the year, three-quarters of a million of which was sold either to or by employees. On December 31, 1924, the company's stockholders numbered 3,208.

The Oklahoma Gas & Electric Company reports for the year ended December 31, 1924, net income of $944,721 after charges but before depreciation, equivalent after preferred dividends to $9.22 a share on the 47,000 common shares outstanding. The company established a record for development and expansion during the year 1924 which stands second only in importance and magnitude to that of the preceding year and marks the culmination of a construction program which added 50,000 hp. to the electrical resources of the territory served. Including customers who are purchasing shares on the monthly investment plan, the company now has in excess of 5,000 preferred shareholders, 1,700 of whom were added under the customer-ownership plan in 1924. The par value sale of preferred shares in 1924 amounted to $1,922,300.

The West Penn Company and subsidiaries, including the West Penn Railways Company, West Penn Power Company and the Monongahela-West Penn Public Service Company, reported gross earnings of $25,469,935, compared with $24,325,406 in 1923, and net of $10,504,682, against $9,850,160, after operating expenses, including maintenance and taxes. Substantial improvements and extensions were completed, including 134 miles of 25,000-volt, 63 miles of 66,000-volt and 73 miles of 132,000-volt transmission lines. There was a net increase in electric customers of 17,188, making a total of 129,320 on December 31, 1924. The number of preferred stockholders of the West Penn Company and its subsidiaries increased from 13,845 on December 31, 1923, to 19,522 on December 31, 1924.

Gross earnings of the Southern California Edison Company in 1924 reached a total of $21,389,499, the largest in the history of this company, exceeding the gross of 1923 by 5.8 per cent. The Southern California Edison Company in 1924 generated 15 per cent more kilowatt-hours than in the previous year—this in the face of restrictions of operation due to the limited amount of rainfall last winter. The total investment in plants and properties and other projects behind the Edison business now totals $195,102,317, or slightly more than the amount represented by the capital structure. During the year net additions of 4,467 were made to the list of stockholders, bringing the total to 70,103. Financing for 1924 was accomplished by the sale of $14,472,500 of stock and $14,000,000 in bonds.

The annual report of the American Water Works & Electric Company for the year 1924 shows gross earnings of $25,469,935, as compared with $24,325,406 for the previous year. Operating and maintenance expenses and taxes amounted to $14,965,252, leaving a gross income of $10,504,682. These figures compare with $14,475,245 in 1923, leaving a gross for that year of $9,850,160. There was an increase in electric consumers during the year of 17,188. During the year 134 miles of 25,000-volt, 63 miles of 66,000-volt and 73 miles of 132,000-volt transmission lines were completed together with the necessary substation equipment.

New Capital Issues

During the first week of April the Jersey Central Power & Light Company offered a four-million-dollar issue of 7 per cent cumulative preferred stock at 97 and accrued dividend, yielding more than 7.20 per cent. The company was recently formed in New Jersey by the merger of several public utility operating companies. This stock, together with $11,500,000 of first mortgage and refunding bonds already offered, is being issued for and in connection with the merger and to retire outstanding obligations.

With the purpose of paying in part the cost of the acquisition of additional properties the Associated Gas & Electric Company issued 30,000 shares of preferred stock at $84 per share and accrued dividend, to yield about 7.14 per cent.

The Pennsylvania Electric Corporation participated in the week's activities with an issue of sinking fund gold debentures, totaling $2,500,000, priced at 93 and accrued interest, to yield over 6.50 per cent.

The Central Power & Light Company,

St. Louis, was represented by means of a million-dollar issue of first lien and refunding gold bonds, the price being 100 and interest, to yield 6.50 per cent. The proceeds from the sale of this entire issue of bonds will be used to reimburse the company in part for additions, extensions and improvements to the properties already completed or in process of completion.

The Alabama Power Company floated a three-million-dollar loan in the form of first mortgage lien and refunding gold bonds, the price being 94½ and interest, yielding about 5.40 per cent. This issue brings the total amount of first mortgage and refunding bonds outstanding up to $28,700,000.

Bosch Magneto Report.—For the year 1924 the American Bosch Magneto Company reported net sales of $10,467,308, against $10,081,439 in 1923. After all deductions net profit amounted to $107,626, against $94,076 in 1923. The net profit for 1924 was equal to 77 cents a share earned on the 138,266 shares of no-par-value capital stock outstanding, against 97 cents a share earned on the 96,000 shares of no-par-value stock outstanding in 1923.

General Electric to Increase Stock.—Stockholders of the General Electric Company at the annual meeting on May 12 will vote on the proposition to increase the authorized amount of special ten-dollar stock from $35,000,000 to $55,000,000. The proposal is made because there is only about $8,000,000 of the authorized special stock remaining in the treasury, over $26,700,000 having been paid to stockholders under the policy followed since 1922 of paying 5 per cent in special stock annually on $180,287,000 outstanding of common stock.

Ohio Power to Expand.—The Ohio Public Utilities Commission has approved the sale of the electric power plant and distributing systems of the Hardin-Wyandot Lighting Company in the cities of Kenton and Upper Sandusky and contiguous territory to the Ohio Power Company. The latter will issue $589,000 of preferred stock and 70,000 shares of no-par-value common stock, delivering all of the common stock and $218,000 worth of the preferred to the Hardin-Wyandot company, using the proceeds from the remainder of the preferred to pay off $371,000 bonded indebtedness of the electric plant.

Niagara, Lockport & Ontario Company to Expand.—The Niagara, Lockport & Ontario Power Company has petitioned the Public Service Commission for consent to merge with it four other companies in western New York, all of the stock of which companies it owns. The companies are the Livingston-Niagara Power Company, Caledonia; Cambria Power Company, Sanborn; Western New York Electric Company, Jamestown, and Bryant Power Company, Inc., Wilson. The Niagara company holds the entire ownership of the stock of these companies under the authority of the Public Service Commission.

Company Reports

Among the company reports recently issued for the month of February are the following:

Name of Company	Gross Revenue for February 1925	1924
American Light & Traction	$405,074	$282,870
Baton Rouge Electric	62,409	59,136
Central Illinois Light	360,855	339,769
Central Mississippi Valley Elec	52,469	50,954
Electric Light & Power Co. of Abington & Rockland	38,125	36,874
Florida Public Service	82,418	47,877
Fort Worth Power & Light	238,491	275,587
Houghton Co. Electric Light	45,546	48,063
Idaho Power	211,946	211,624
Kansas Gas & Electric	540,248	537,749
Keokuk Electric	36,398	35,376
Key West Electric	21,557	20,687
Mississippi Power & Light	128,794	107,777
Nebraska Power	367,514	346,117
New Bedford Gas & Edison Lt.	330,555	308,891
Northern Ohio Power	926,962	699,693
Pacific Power & Light	270,065	263,739
Paducah Electric	55,674	55,404
Penn Central Light & Power	353,941	311,603
Puget Sound Power & Light	1,090,248	1,072,348
Rutland Ry., Light & Power	43,542	48,942
Sayre Electric	23,416	19,552
Sierra Pacific Electric	93,424	84,400
Southern Canada Power	99,133	94,044
Southern Indiana Gas & Elec.	222,499	237,178
Texas Power & Light	593,674	542,301
Utah Power & Light	800,725	781,616
Vermont Hydro-Electric	64,876	62,312

Increase in Capitalization.—Amended articles of incorporation increasing the capital stock of the Dixie Power Company, St. George, Utah, from $800,000 to $1,000,000 have been filed in the office of the Secretary of State of Utah.

Adirondack Company Seeks Acquisition.—The Adirondack Power & Light Corporation has applied to the New York Public Service Commission for authority to purchase all or part of the outstanding capital stock of the Consolidated Electric Company of Greenwich, Washington County, N. Y.

Canadian Westinghouse Report.—The report submitted at the twenty-first annual meeting of the Canadian Westinghouse Company, Ltd., showed net profits of $1,139,369 and dividends paid of 10 per cent for the year ended December, 1924. Gross earnings amounted to $1,541,369, from which was deducted $136,000 as a provision for payment of Dominion taxes for last year, $246,000 for depreciation of property and plant and $20,000 for the company's pension fund. From the net profits the company paid dividends at the rate of 8 per cent and a special dividend of 2 per cent, amounting to $743,280, which left a balance of $396,079 to be carried forward to the profit and loss account.

Japanese Company Floats Fourteen-Million-Dollar Loan Here.—The Ujigawa Electric Power Company, Ltd., recently offered for public subscription through Stone & Webster, Inc., Lee, Higginson & Company, the Guaranty Company, Harris, Forbes & Company and Brown Brothers & Company an issue of first mortgage 7 per cent sinking-fund gold bonds totaling $14,000,000. The Ujigawa Electric Power Company, Ltd., is one of the larger and older hydro-electric power companies in Japan, owning seventeen electric power plants, hydro-electric and steam, of 157,019 hp. capacity. Sales in kilowatt-hours in 1924 were over 540,000,000. The bonds were priced at 91 and interest, yielding over 7.90 per cent. Proceeds will be used to retire existing funded indebtedness incurred for additions to properties and for increasing working capital.

Kelvinator Issue Oversubscribed Twelve Times.—The issue of stock of the Kelvinator Corporation of Detroit offered to provide for expansion, as announced recently in the ELECTRICAL WORLD, was oversubscribed twelve times. Applications were on file for fully 600,000 shares with only 50,000 available.

Stockholders' Rights to New Capital Stock.—The stockholders of the Washington Water Power Company of record April 6 will be given the right to subscribe at par on or before June 1 to new capital stock in the ratio of one new for each existing ten shares. The proceeds are to be used for extensions and improvements and for reducing short-term indebtedness.

Utah Securities Stockholders Approve Directors' Action. — Utah Securities Corporation stockholders at a special meeting held at Richmond, Va., ratified the action of the directors of the company in adopting the plan for the sale of all its properties and assets to the Electric Power & Light Corporation. The stockholders also voted to dissolve the corporation.

Associated Gas & Electric Creates New Preferred. — Associated Gas & Electric Company directors have approved the creation of a new preferred stock issue to be known as the six-dollar dividend series. The authorized amount of the issue is 125,000 shares, of which 30,000 shares have been offered during the past week. The new stock has a stated value of $100 per share and ranks equally as regards preference to assets and dividends with the old preferred of $50 stated value. Associated Gas & Electric Company has acquired since January of this year new electric light and power properties with approximately $1,000,000 annual gross revenues. Proceeds of the new financing will be used to pay in part the cost of acquisition of these properties.

Increase in Capitalization of Metropolitan Edison.—The stockholders of the Metropolitan Edison Company will vote May 5 on increasing the authorized preferred stock from 75,000 shares to 375,000 shares and the authorized common stock from 300,000 shares to 500,000 shares. It is proposed to classify the present outstanding 75,000 shares of cumulative participating preferred stock, the annual dividend on which is $7 per share, as "series A" and not to authorize the issuance of any more of this stock. According to the plan, 150,000 shares of the proposed cumulative preferred stock, which will be non-participating, will be classified as "series B." The remaining 150,000 shares will be known as "series C" and the annual dividend on these shares will be $6. No change in classification of the common stock is proposed. The stockholders will also vote on increasing the authorized indebtedness of the company from $20,000,000 to $50,000,000.

Stock and Bond Quotations of Electric Light and Power and Manufacturing Companies

(Prices on New York stock market unless otherwise noted. Unless otherwise noted the par, stated, or preference value of stocks is $100.)

Companies	Bid Price Saturday, April 4	Low 1925	High 1925
PREFERRED STOCKS			
Operating Companies			
Adirondack Power & Light 7 per cent	99	98	102
Appalachian Power, 7 per cent	97½	92	100
Arkansas Light & Power 7 per cent	93	92	98
Asheville Power & Light 7 per cent	a 99	99	100
Central Illinois Public Service 6 per cent	90	84	93
Colorado Power 7 per cent	94	93	98
Connecticut Light & Power 7 per cent	106	105	110
Consumers' Power 6 per cent	91	90	93½
Dayton Power & Light 6 per cent	92	88	100
Duquesne Light 7 per cent	a107	105	107¾
Eastern Texas Electric 6 per cent	100	100	105
Empire District Electric 6 per cent	78	78	85
Fort Worth Power & Light 7 per cent	a101	100	102
Great Western Power 7 per cent	98	...	...
Illinois Northern Utilities 6 per cent	88	82	92
Illinois Power & Light 7 per cent	94	92½	98
Kansas Gas & Electric 7 per cent	a 98	98	100
Long Island Lighting 7 per cent	102	100	105
Minnesota Power & Light 7 per cent	a 96	96	98
Mississippi River Power 6 per cent	90	87½	92
Nebraska Power 7 per cent	a 98	98	100
Niagara Falls Power 7 per cent—25	28½	28	29
Niagara, Lockport & Ont. Power 7 per cent	105	101½	110
Northern States Power 7 per cent	97	95	100
Ohio Public Service 7 per cent	96	96	100
Pacific Gas & Electric 6 per cent	94½	92	97
Pacific Power & Light 7 per cent	a 98	98	100
Penn-Ohio Power & Light 7 per cent	93	91	100
Pennsylvania Power & Light $7—no par	a101	100	101½
Penn. Public Service 7 per cent	90	90	100
‡Philadelphia Electric 8 per cent—25	39½	38¾	45
Southern California Edison 8 per cent	118	115	122
Tennessee Electric Power, 6 per cent	81	80	84
Texas Power & Light 7 per cent	a100	100	101
Utah Power & Light 7 per cent	a 98	97	99
Western States Gas & Electric 7 per cent	89	82	89
Yadkin River Power, 7 per cent	a 99	98	100
Holding Companies			
American Gas & Electric 6 per cent—100	86	86	89
American Light & Traction	95	93	97
American Power & Light 6 per cent	86	86	90
American Public Service 7 per cent	91	88	94
American Public Utilities 7 per cent	87	87	95
American Water Works & Electric 7 per cent	a101½	100	103
Associated Gas & Electric 7 per cent—1 per cent extra—no par	a 51½	...	...
Carolina Power & Light 7 per cent	101	100	105
Central Indiana Power 7 per cent	89	88	95
Cities Service 6 per cent	81	80	83
Commonwealth Power 6 per cent	81½	80	82½
Consolidated Gas 6 per cent—50	57½	57½	58½
Continental Gas & Electric 7 per cent pr. pf.	91	89	95
Electric Bond & Share 6 per cent	102½	102	104
General Gas & Electric—$8—no par	109	104½	111
*Middle West Utilities 7 per cent	96½	91½	98½
National Power & Light—$7—no par	95	95	99
North American 6 per cent—50	48½	46¾	49
Public Service Corp. of N. J. 7 per cent	101½	99	102
Public Service Corp. of N. J. 8 per cent	110	108¾	112½
§Standard Gas & Electric 8 per cent—50	a 51	50½	53½
†United Gas Improvement—50	57½	56¾	58½
United Light & Power—$6.50—no par	81	81	88
COMMON STOCKS			
Operating Companies			
Adirondack Power & Light—50	39	31	42
Appalachian Power—no par	77	70	83
Arkansas Light & Power	75	65	85
Brooklyn Edison	a130½	120½	133
Buffalo General Electric	245	197	250
*Commonwealth Edison	134½	134½	139
§Consolidated Gas, Electric Light & Power	34½	32	35½
Dayton Power & Light	420	180	460
Detroit Edison	a116	110	119
|| Edison Electric Illuminating of Boston	200½	200	206
Kentucky Hydro-Electric	92½	85½	92½
Long Island Lighting	65	60	85
Mississippi River Power	39	37	42
Montana Power	a 65½	64¾	72
Niagara Falls Power—no par	56	45½	58
Niagara, Lockport & Ontario Power—no par	60	60	73
Northern Ohio Power	6½	5	7½
Northern States Power	108	103	110
North Texas Electric	60	60	70
Pacific Gas & Electric	a105½	102½	108½
‡Penn Central Light & Power—no par	63½	60	64½
§Pennsylvania Water & Power	129½	126½	133½
‡Philadelphia Electric—25	39¾	38½	45¾
Public Service Co. of Northern Illinois	114	97	116
Puget Sound Power & Light	49	49	58
Southern California Edison	103½	102	106
Tennessee Electric Power—no par	51	47	61
Virginia Power	60	60	92
Virginia Railway & Power	a 79¼	64¾	86½
West Penn. Co.	113	105	120

Companies	Bid Price Saturday, April 4	Low 1925	High 1925
Holding Companies			
American Gas & Electric—no par	70	70	80
American Light & Traction	145	139	153
American Power & Light	52	52	67
American Public Utilities	74	70	85
American Water Works & Electric	a 46½	34¾	49
Associated Gas & Electric, Class A	a 26	...	...
Carolina Power & Light—no par	330	290	350
Cities Service	175	172	210
Columbia Gas & Electric—no par	a 57½	45¾	59
Commonwealth Power Corp.—no par	106	106	126
Consolidated Gas—no par	a 77¼	74¾	78¾
Continental Gas & Electric	80	80	90
Electric Power & Light	a 14½	14	14¾
Federal Light and Traction	a141	114½	148½
General Gas & Electric	80	72	82
Lehigh Power Securities—no par	92	82	116
*Middle West Utilities—no par	90½	82½	102½
National Power & Light—no par	230	185	245
North American—10	a 46½	41¾	49
Philadelphia Co.—50	a 52½	51½	57½
Power Securities—no par	15	...	...
Public Service Corp. of N. J.—no par	c 66½	62½	72½
Standard Gas & Electric—no par	a 44¼	40½	47½
United Gas & Electric (Conn.)—no par	28	26	37½
Utah Securities	a 67½	41½	69½
BONDS			
Operating Companies			
Adirondack Power & Light	6s 1950	104½	102½ 105
Alabama Power	5s 1946	97½	96 98
Appalachian Power	5s 1941	97	96 97½
Brooklyn Edison	5s 1949	100½	99½ 100½
	6s 1930	104½	104½ 105
Cleveland Electric Illuminating	5s 1939	100½	100 101½
Commonwealth Edison	5s 1943	100½	99½ 101
	5s 1953	99	98½ 99½
Consol. Gas, Elec. Lt. & Pwr.	4½s 1935	96½	93½ 97½
	§6s 1949	106½	104½ 106½
Consumers' Power	5s 1936	99	99 99½
	5s 1952	94½	90½ 95½
Detroit Edison	5s 1933	101½	99½ 102½
Duquesne Light	6s 1949	105½	104½ 107
Great Western Power	5s 1946	97	95 97½
Kansas City Power & Light	5s 1952	97½	95½ 98½
Mississippi River Power	5s 1951	98	96½ 99
Montana Power	5s 1943	98½	97½ 99½
New England Power	5s 1951	100½	100½ 101½
New York Edison	6½s 1941	114	112 115
Niagara Falls Power	6s 1950	106½	105 106½
Northern States Power	5s 1941	95½	93 96½
	6s 1941	104½	103 107½
Ohio Power	7s 1951	106½	106½ 107½
Pacific Gas & Electric	5s 1942	95½	93½ 96
Pennsylvania Water & Power	5s 1940	100	99½ 101
‡Philadelphia Electric	5s 1966	100½	100½ 102
	5½s 1947	105	103½ 105
	6s 1941	107½	106 107½
Portland Electric Power	6s 1947	96½	94 99½
Southern California Edison	5s 1939	99	99 100½
	6s 1944	103½	102½ 104½
Tennessee Electric Power	6s 1947	100½	99½ 102½
Texas Power & Light	5s 1937	96½	96½ 98
Toledo Edison	7s 1941	109½	108½ 110
Utah Power & Light	5s 1944	93½	91 95½
Holding Companies			
Alabama Traction, Light & Power	5s 1962	89	86 90
American Gas & Electric	6s 2014	96½	96½ 97
American Power & Light	6s 2016	95	94 95½
Amer. Water Works & Electric	5s 1934	95½	92½ 96½
Associated Gas & Electric	6½s 1954	a100	... ...
Central Indiana Power	6s 1947	97½	95½ 98½
Commonwealth Power	6s 1947	100½	97½ 101
Consolidated Cities Lt., Pwr. & Tr.	5s 1962	79½	75½ 80½
Illinois Power & Light	6s 1953	101	100½ 102
United Light & Railways	5s 1932	94	93½ 94½
	6s 1952	97½	95½ 99½
ELECTRICAL MANUFACTURING COMPANIES			
PREFERRED STOCKS			
Allis-Chalmers Manufacturing	a103½	103½	107
*National Carbon	120	120	124
Worthington Pump & Machinery B	a 65	65	76½
COMMON STOCKS			
Allis-Chalmers Manufacturing	a 79½	71½	86½
American Bosch Magneto—no par	a 32½	26½	54½
Electric Storage Battery—no par	a 62½	60½	70½
General Electric	a262½	227½	320
General Electric—10	a 11½	11	11½
*Hurley Machine—no par	46½	41½	56
†Wagner Electric	33½	26½	50
Westinghouse Electric & Manufacturing—50	a 68½	66½	84
Worthington Pump & Machinery	a 49½	45	79½
BONDS			
Canadian General Electric	6s 1942	107¾	107¾ 107¾
General Electric	3½s 1942	83½	83 84
	5s 1952	104	101½ 105½
Robbins & Myers	7s 1952	66	66 73½
Western Electric	5s 1944	99½	98 99½
Westinghouse Electric & Mfg.	7s 1931	108	107½ 108½

*Chicago Stock Exchange. †St. Louis Stock Exchange. ‡Philadelphia Stock Exchange. || Boston Stock Exchange § Baltimore Stock Exchange.
a Bid price, low and high, Tuesday, April 7.